

THE TELEGRAPHIC JOURNAL AND
Electrical Review.

VOL. XXIII.—No. 574.

BLOCK SIGNALLING.**THE WHITMORE JUNCTION ACCIDENT.**

THE enquiry into this accident is serviceable as showing the necessity of the establishment of a proper code of signals, or the employment of efficient indicating instruments for the several roads open to trains working through crowded stations or junctions.

The accident was the result of a collision between a special passenger train from Doncaster to March, and a goods train which was on its way from March to Whitmore, and which had been brought to a stand at the Whitmore Junction down home signal. The collision occurred when running into the March station about 10.40 p.m. on the 12th September.

Through March station there are four lines of rails, the up and down main lines being on the south side, or down side, of the up or down through lines.

At Whitmore there are three double junctions: first, that of a back curve from the Peterboro' line; secondly, that of the goods line into Whitmore goods yard; and thirdly, that of the line to Wisbech. Whitmore Junction cabin lies between these junctions on the east side of the railway, here running north.

It will thus be seen that the junctions with the several lines are somewhat complicated, and the signals are not less so, being difficult in some places to see, and at others overlapping in an inconvenient manner.

The evidence produced would go to show that no blame was attributable to either of the drivers or to the signalman at the Whitmore Junction. The collision was the result of a mistake on the part of "the signalman in March north junction cabin who, having allowed the goods train to pass his down through line junction home signal, after it had been accepted from Whitmore Junction cabin, accepted from Whitmore Junction, and lowered his home signal for, the special train to run into the station upon the down main line side, although the goods engine was standing on the crossing of the junction, the Whitmore Junction down signal being at danger. In this position the engine was well within his view, being only 84 yards from him: and he admits he forgot all about it."

It would appear that the Whitmore Junction signalman when he accepted the goods train had no means of knowing whether it was coming off the main or through lines, and as it would not in the former case have been foul of the junction, and as, moreover, he could not see it from his cabin, he very naturally is not blamed for offering to the North Junction the up special train.

This brings us to the main point in question, so far as the duties of this journal are concerned, viz., the fact that although a bell communication existed be-

tween the two cabins, there appears to have been no means adopted for indicating the road upon which trains would proceed. With regard to this Major Marindin says:—"Considering the position of the signal cabin, and the impossibility of giving as good a view of the line from it as might be wished, it would be an advantage for the signalman in Whitmore Junction cabin to know whether a train signalled to him from North Junction cabin is approaching upon the down main or the down through line, and it would be easy to arrange for the bell signals to be distinctive."

We not only concur in this recommendation, but we will go a little further, and suggest the propriety under such circumstances as here existed of providing an independent indicator or block instrument for each road, so that there may be no mistake. Bell signals are of course preferable to nothing, but an independent indicator for each road is still more preferable as being more reliable. We think we might even go beyond this. We are not acquainted with the whole details of the junction, or section of line in question, but from the description of it we should imagine no difficulty would attend the locking of the signals electrically, so that only that signal for the road by which a train was to be allowed to approach could be drawn off. Such a provision would undoubtedly render the working as nearly secure as the means at our present command will admit. We believe that far greater security is to be obtained than now exists by the judicious application of electrical locking, or interlocking, especially at points where a complication of signals, junctions, and multiplication of roads exists.

WE were fortunate, or perhaps it would be nearer the truth to say unfortunate, enough to witness the Barnet electric light installation in all its glory on the evening of Friday last. Whether the representative of our estimable contemporary, the *Electrical Engineer* was specially favoured on the occasion of his visit, or whether he was in that happy frame of mind which the contractor, in a letter to us appearing in the REVIEW for Oct. 19th, attributed to the correspondent of the *Blyth Examiner*, we cannot undertake to say, but we do assert that on Friday evening last the electric lighting of Barnet was in no respect superior to that of ordinary gas lamps. The filaments were in various stages of incandescence, the light from several being decidedly inferior to gas, and as the number of lamps in circuit falls short by some dozens of the number of displaced gas jets, we can only conclude that if the illumination witnessed by us represents the normal state of the Barnet streets, the inference is obvious. We have no desire to make matters worse than they are, but we do think that it is decidedly bad policy to blind one's self to actual facts as they exist, and we therefore feel that our contemporary showed somewhat bad taste in attributing to the gas journals and the local press, a desire to disparage the installation generally. Surely gas journals can give their honest convictions, and we find that they are not invariably behindhand in bestowing praise, even to electric lighting, where praise is due.

THAT Messrs. Crompton & Co., Limited, should pose in electric lighting business (*vide prospectus*) in the

same manner as does the Telegraph Construction and Maintenance Company towards submarine cable manufacturing, appears to us to be scarcely feasible. If, for instance, the Metropolitan Electric Supply Company could secure a monopoly for electric lighting, and appoint Messrs. Crompton their contractors, the suggestion might be admissible, but this is scarcely probable. The history of the T. C. and M. Company with regard to the cable industry is, we imagine, of a nature one would scarcely care to see repeated in another way, although it might of course be an excellent thing for Messrs. Crompton & Co. That such a *dénouement* is, however, unlikely appears patent from the fact that the Westinghouse Company is also in the field.

It has been proposed to increase the Board of Trade unit from 1,000 watt hours to ten times that amount. What is the opinion of our readers upon this proposition?

How long will Mr. J. E. H. Gordon remain faithful to his new love? This is a question which seems to be agitating the minds of a certain portion of the electrical fraternity who do not much believe in periodical conversions from one faith to another. There is, however, a great advantage in being cosmopolitan even in matters of belief.

"A SPECIAL dispatch from London last week says:— 'George Westinghouse's electric company has been awarded the contract for a plant to light the City of London, to cost about \$300,000. It will be the largest plant in the world.' We understand that the sale above referred to has been made to the Metropolitan Electric Supply Company, and that the apparatus for a first instalment of the total 25,000 lights contracted for is already on the spot. We are glad to see that American electric lighting machinery has once more captured the English market." Thus saith the New York *Electrical World* of the 10th inst. Now why is it that American contractors can beat us on our own ground? We can scarcely believe it to be on the score of price, and we fail to see how it is on the ground of extra efficiency, as we understand the specification was elaborate and doubtless conformed to in every particular by the English firms tendering. It is rumoured that the English tenders were delivered to time but that the American was not, nearly a month elapsing pending its arrival, but of course we cannot venture to say when they were opened. Many people will feel disgusted that the technical advisers of the Metropolitan Electrical Supply Company should have allowed an order of this kind to go across the water. It will seem to some that it is an insult to English engineers, for things are bad enough here without our own men passing us over. It is not as if we would or could not do the thing decently. Foreign competition would no doubt come in any case, but we surely need not send for it? Our learned professors dabble far too much in these commercial matters, and should have their fingers rapped. We believe we are not mistaken in asserting that one of the advisers to the Metropolitan Company is not entirely uninterested in Westinghouse, but even he in his B. A. description of the Westinghouse system said:—"I do not in the least wish to say that the American arrangements are the best." There is probably more than meets the eye in this, and a contemporary, perhaps unthinkingly, may have afforded a clue. It said:—"It is to be remembered that the

Westinghouse Company owns a considerable number of patents taken out by English inventors." If it can be shown that any of these inventors and patentees are also consulting engineers to the Metropolitan Company—well, it will be a blot on their fair fame. Moreover the directors, Messrs. Pender, Anderson & Co., cannot well pose as patriots. It must not be supposed that we are commenting upon this topic in a spirit of pique at the contract having gone out of the country, for we do not think it will be gainsaid that English enterprise in the States is far greater than the Americans can give us any equivalent for here, and has not a Ferranti plant already found its way across the Atlantic? The circumstances, however, under which this business has been transacted appear to make it desirable that a little more light should be shed upon the matter if only for the sake of pacifying the angry feelings to which it has given rise in electrical circles.

THE example of laying down Callender-Webber conduits for the Whitehall Central Station is being followed in New Haven, Conn., where several miles of similar duct were commenced on the 25th ult. by the American Callender Company.

At the meeting of the New York Board of Electrical Control, on the 30th ult., Chief Engineer Kearney and Expert Wheeler presented their report on recent investigations in the matter of the excessive heat in the subways. The report says: "The sole cause of the trouble is the heat caused by the escaping steam from the pipes. This brings the temperature of the conduits up to a point which none of the cables as ordinarily made for underground work can stand, and it is doubtful if any practical cable can be made which can stand the high temperature, and at the same time be waterproof. All of the substances used as insulation in making waterproof cables are organic compounds which either melt or become soft at a high temperature, in which case they both deteriorate as insulators, and run and drip off the wires as well, or they become charred or burned, and thus lose their insulating properties, and crumble or drop off the wires. In order to avoid all of these materials, which are rendered useless by the heat met with, we decided to enquire into the probable chances of a cable covered with some woven fabric, but left dry, that is, not treated with any fusible substance, such as wax or rubber, relying upon a lead-pipe covering to keep the water out. We found that precisely such a cable has been laid by the Metropolitan Telephone Company across Broadway at Ann Street, where a high degree of heat was met; but unfortunately this has not been put in use yet, and we were not able to get its results. The telegraph company laid a similar cable about two years ago, which gave out, but the cotton had been treated with some substance, which may have impaired it, and the lead covering was injured enough to admit water. These were the only two cases we could find of an effort having been made to make cables which would stand this heat, but unfortunately neither is a criterion. The remedy is unquestionably with the Steam Heating Company in stopping the leaks. The problem of making a cable to stand the heat is one of great difficulty and uncertainty as to the results, if it is possible at all. The heat caused by the steam leakage on Broadway was so great at the time the cable spoken of was laid two years ago that it expanded the brass pneumatic dispatch tubes of the

Western Union Company, and crushed their ends against the brick junction boxes. A lead covering for cables will carry off some of the heat at first, and in some cases where the heating is temporary or local such a covering will be sufficient protection. A communication from the telephone company also showed that tests of the new cables parallel to the steam pipes had been seriously injured by the heat, it being impossible to preserve the insulation." Luckily we shall not have to deal with the matter of steam pipes when the question of putting our wires underground assumes a threatening form.

MR. GEORGE A. MAYO, the electrician of the Van Depoele Company, has been interviewed on the subject of electric shocks. Mr. Mayo received a shock of 3,200 volts some two years ago while acting as electrician of the Narragansett Electric Light Company, of Providence, R. I. This, it is claimed, is the heaviest shock of electricity that a human being ever survived. Mr. Mayo was thrown on a 50 arc light dynamo, and received the full force of the current. His sensation on first receiving the shock, he states, was not at all unpleasant, and there was absolutely no pain, it instantly destroying all feeling except the roaring in the ears, and he compares the effect upon the system with that of laughing gas. He thinks he retained his senses for perhaps 30 seconds. The treatment used to restore him to consciousness was the use of several buckets full of water, and hard rubbing. His hands were terribly burned, but aside from that he received no permanent injury, save that he thinks his nervous system never quite recovered from the shock. Mr. Mayo is hardly in favour of the law in the State of New York requiring the infliction of the death penalty by means of electricity, inasmuch as it has not, so far, been practically demonstrated what shock is necessary to kill absolutely and under all circumstances without a hope of resuscitation.

THE New York *Electrical World* thinks that American experience, if nothing else, has given its countrymen a very thorough knowledge of the various problems in electrical engineering and of the best solution for them. It is not a good division of labour, says our contemporary, for America to do all the hard work and Europe to do all the fault finding. The suggestion for exchanging some of the practical men of the States for a few foreign critics is a good one, for assuredly the importations would make matters more lively on this side. On the whole, however, we think that genuine American enterprise is highly appreciated here and that criticisms, speaking for ourselves, are more generally directed at the number of senseless schemes which are always being promoted as examples of American smartness of a questionable character. Mr. Sprague's work, for instance, is deserving of the highest commendation, for the difficulties which his ability and energy have surmounted would have altogether disheartened the majority of Englishmen.

THE House-to-House Electric Supply Company, Limited, has recently sent copies of a letter and circular descriptive of its operations to the inhabitants of West Brompton, Earl's Court, South Kensington, and neighbourhood, intimating that on December 15th the West Brompton Central Electric Light Station will be opened. The terms on which the light will be supplied are given in our other pages.

THE London correspondent of the New York *Electrical World*, whose judgment is doubtless based upon ripened and practical knowledge, thinks that it will be surprising if the London Electric Supply Corporation, with its large experience, backed up as it is by capital and intelligence, should fail to succeed. It is devoutly to be hoped that the opinion expressed above will turn out to be correct, but no man is a prophet in his own country.

ORGAN blowing by means of electric motors seems to be making headway in America, and we hope the time is not far distant when we shall see progress of the same kind gaining ground in England, although this is not likely to become general until we have companies in existence who can supply electrical energy for all purposes, as is the case in the States. The advantages of these motors over any other power yet in use are many. The most prominent are the steadiness of its motion; the fact that the power is under the control of the performer; the compactness and very low cost of plant and running expenses; and the freedom from parts likely to wear or to get out of order. The motor used at St. Paul's Chapel, Broadway and Vesey Street, New York, is pronounced perfect by all who have witnessed it in operation.

THE cheaper evening papers no doubt circulate largely amongst the lower classes of the community, and their influence is therefore by no means small. This being the case, is it too much to ask that those who conduct them should exercise some degree of circumspection with regard to the matter they place before their readers? A glaring instance of the manner in which poor people may be misled, by those to whom they are entitled to look for some amount of guidance, into the fruitless expenditure of hard-earned money in the pursuit of health is afforded by a recent issue of the *Evening News*, in which appears a glowing account of the visit of a representative, who avowedly knew as little of electrical science as a South Sea Islander of skating on ice, to an "Electropathic Establishment." Let our evening contemporary, if it really cares to put the truth before the world, send again, but this time some one with a greater knowledge of electrical science than that possessed by the writer of its recent article. Perusal of a few back numbers of the *ELECTRICAL REVIEW*, also, might assist the editor to form a more correct opinion respecting the curative properties of electrical appliances than he probably now holds.

WHAT is wrong with the Electrical Automatic Box Company? It has now been in existence nine months, yet seemingly has done nothing. London still waits for its electrical automatic delivery boxes. A doubt has been raised as to whether the company really and fully possesses the patents upon which it was to work. The patentee was to receive £30,000 for his invention, £10,000 in cash and £20,000 in shares. Possibly the £10,000 in cash has not yet been forthcoming, and the patentee has withheld his patent rights. The *Financial News*, which has a keen scent for jobs and doubtful schemes, says the company in its present form appears to be quite a nice little family party, composed of the representatives of the Contract and Agency Corporation, which promoted it, and that it is a pity that outside investors should have struck in at all to spoil the symmetry of the arrangements.

AN ITALIAN COMMISSION ON ELECTRIC TRACTION.

THE Società Anonima degli Omnibus of Milan, which owns some of the most successful tramways in Italy, has for some time considered the subject of electric traction of sufficient importance to deserve a full inquiry, and with a view of obtaining independent testimony the company selected three engineers of high reputation to travel through Europe, see the various electric tramways, report upon the results of their experiences and at the same time offer suggestions to the board of directors in whose interests the commission had to act. This technical commission was represented by Messrs. Pompeo Moneta, C. Margutti and B. Cabella. The exhaustive report before us was drawn up by Mr. Moneta and entitled "Sull'Applicazione dell'Elettricità alla Trazione delle Vetture sulla Guidovia Milano-Monza," having reference to a scheme of adopting electricity as a mode of traction on the Milan-Monza tramlines in the first instance. Previous to the contemplated European tour a series of meetings was held in Milan to consider the main questions bearing upon the special case, and a separate committee, composed of Messrs. Canzi, Esengrini and Peregrini, drew up a programme which practically consisted of a series of questions on the subject under consideration, particular stress having been laid upon the adaptability of storage batteries, since it was determined beforehand that no conductor system could be applied to the case primarily in view.

Although most of the electric tramways which are worked by overhead, underground and rail conductors have been visited, these are only mentioned incidentally in the text of the report. Interesting as many of the passages are, we cannot give more than a few extracts, since our space does not permit of a translation in extenso of a pamphlet containing 61 pages in print. Most of the time was spent in Belgium and England where a careful study of the storage battery industry could be indulged in, and it is stated in flattering terms that the commission did not set out on its journey until advices had been received of Mr. Reckenzaun's return from the United States, he being recognised as the most competent engineer to consult with on this important question. The commission would have been glad if they had been able to find a line operated by storage battery cars of which they could have reported as being an entire financial success. The system in Brussels had not given full satisfaction; there electric traction turned out to be more costly than horse traction by as much as 4 centimes per car kilometre. Various improvements had been made recently which may tend to decrease the cost, but no reliable data are to be had concerning the effects of these changes. But Mr. Moneta modifies his opinion by stating that a service with a few electric cars ought not to be conclusive evidence of want of economy, no more than a tramway worked by a few horses could be taken as a basis for an estimate of a line with many cars. Moreover, the Rue de la Loi, where the cars run, is a very difficult one, since it contains long gradients of 3.12 per cent., consequently on a less difficult line the results would be much better.

In London the line between Stratford and Manor Park had been inspected, but none of the Elieson locomotives were at the time in operation. During the six months previous to suspending electric traction a large number of passengers had been carried, amounting to an average of 475 persons per day. The commission does not express a favourable opinion upon the idea of using separate locomotives for electric traction, giving reasons in this particular case.

A careful study was made of the accumulators of the Electrical Power Storage Company, as well as those of Julien, Reckenzaun, Elwell-Parker, Elieson, Farbak-Schenek, and Desmazures, the manufacturing processes

of each having been inspected and data from independent sources collected. The storage capacity, weight, rate of charge and discharge are given in most cases; but as regards durability, or cost of maintenance, the E.P.S. Company and Mr. Reckenzaun are the only ones, according to this report, who give an absolute guarantee in money value per annum. Reckenzaun's plates have been tried in every way; they have been bent in all shapes, rolled up into cylinders, thrown violently on the floor, but none of the active material was disturbed.

With regard to the efficiency of tramcar cells the results obtained by Prof. Waltenhofen in Vienna are given; this is stated to be 81 per cent. with Reckenzaun's and 83.4 per cent. with Julien's battery. But the commission does not rely upon such tests, and assumes in its calculations concerning the probable cost of traction an average efficiency of but 60 per cent.

A chapter is devoted to motors and gearing. Mr. Reckenzaun's plan is spoken of as the most rational from an engineer's point of view, and all the details are discussed at length, whilst comparison's are drawn with other systems in vogue. Mr. Moneta favours the use of two motors on each car, so that in case of an accident to one the other can finish the journey; also that four driving wheels must be superior to two wheels in point of traction, especially where gradients occur. He, moreover, admires Reckenzaun's method of varying the speed and power by varying the natural resistances of the motor coils in coupling them in different ways through a switch, whereby the E.M.F. of the storage battery can be kept practically constant.

At Brighton, the author found that the leather link belt gave satisfaction for transmitting the power of the motor to the car axles, but in this case it was applied to a small and light car. The new gearing of S. S. Scott and Co., recently adopted on one of the Blackpool cars, is spoken of as promising to give good results. Various kinds of gearing are being used in other cases, and imperfections gradually eliminated as experience advances, notably, chain and toothed-wheel gearing.

Doubtless the most interesting part of this report, as far as the shareholders of the company are concerned, is the chapter relating to the cost of electric traction. This estimate is carefully prepared, and the figures are based on the market prices of steam engines, boilers, dynamos, accumulators, and accessories. The depreciation of machinery corresponds with the average known percentages, the cost of fuel and the H.P. has been calculated from recognised coefficients of traction on tramways, whilst the maintenance of accumulators and the efficiency of the propelling apparatus has been taken from the guaranteed figures of manufacturers. Mr. Moneta arrives thus at very approximate costs of running eight large cars, each carrying 50 passengers, on the Milan-Monza line, which is about 16 kilometres long, and at present worked with horse cars. Severe gradients do not occur on the line, but the 16 kilometres have to be traversed within the space of 58 minutes, including all stoppages on the road. This cannot be accomplished by horses, but it is highly desirable, on various grounds stated in the report, that a faster service be instituted, hence the suggestion of adopting electric traction. With an average speed of 16 kilometres per hour, the cost per car kilometre comes to 25 centesimi. The items of the estimate include fuel, oil, waste, ordinary repairs, wages of electrician, engineer, mechanics, firemen, and labourers. Then a technical director, rent, contingencies; furthermore, for annual depreciation and renewals of steam engines, boilers, dynamos and motors, 12.5 per cent.; of accumulators, 30 per cent. (including freight, if imported); and, lastly, 6.5 per cent. interest on the entire capital invested in machinery and apparatus.

The report, which is one of the most rational of the kind we have ever seen, concludes with the recommendation that electric traction should be tried on the Milan-Monza line, and that it would be an honour to Milan, which was one of the first cities in the world to adopt electric lighting on a large scale, to be also one of the first to utilise electricity for the propulsion of its tramcars.

THE REMINGTON TYPE WRITER.

ON Saturday last, at Anderton's Hotel, Fleet Street, there was held an interesting exhibition of the various forms of the Remington type writer, the special object in view being to introduce to representatives of the press a new form of the machine about to be placed upon the market, which is to be known as the No. 5, and is the embodiment of a number of improvements by which the following advantages are gained as compared with the machines hitherto in use:—

(1) Paper of a greater width can be used, and accordingly a lengthened line of type. (2) Four extra keys, giving eight additional characters, are introduced, making it possible to apply fraction marks and other commercial signs. (3) The machine is made to respond more quickly to the touch. (4) Perfect alignment is ensured. Every part of the machine has been simplified and strengthened, thus assuring ease of manipulation and increased durability. (5) The "dog movement" is simplified so that even the non-mechanical can adjust it. (6) The carriage can be pushed from left to right without injury to the machine. (7) By means of manifold plates perfect alignment is ensured even when making as many as 15 or more copies at one time. (8) There are three line spacings in place of two. (9) The ribbon attachments are a part of the machine. (10) In addition to the above there are at least eleven other improvements that tend to add to the speed, the simplicity, durability or manifolding qualities of the typewriter.

As might have been anticipated in a gathering of Press men, great interest was taken in the manifolding capabilities of the machine, and an operator demonstrated the method of taking five or six copies at a time. It is stated, however, that by using thin paper and employing a machine with a hard cylinder, as many as 20 copies of the same document may be printed at once, all of which are of course absolute counterparts requiring no comparison. The new machine is improved in appearance, being better proportioned than its predecessors, as well as more handsomely finished, and the simplicity, ease, and speed with which it is manipulated are remarkable. At the International Typewriting Contest at Toronto in August Miss M. E. Orr in 10 minutes wrote with a Remington typewriter 987 words, an average of nearly 99 per minute, so that the following comparison made by the manufacturers does not seem to be overdrawn:—"The average speed of the pen is from 15 to 25 words per minute; the average speed of the typewriter from 40 to 80 words per minute. Time spent in writing with the pen is therefore two-thirds wasted." It is only very recently that the claims of the typewriter as a labour-saving machine have been recognised in this country, but the demand now is a large and rapidly increasing one, those who use the typewriter testifying that it results as compared with penmanship in a saving of time, that letters written by its means are neater and more legible, that less paper is used, which is of importance in foreign correspondence, and that a letter written in English is more easily deciphered by foreigners who do not understand the language thoroughly. The possibility of producing a number of copies simultaneously often renders unnecessary an outlay for printing, and the process is far preferable in the case of confidential documents. These considerations, and the additional inducement that the new 1888 machine is as near perfection as possible, should lead to a much more general use of the Remington typewriter, which is well worthy a place wherever writing has to be habitually done.

Lighting of the Edinburgh Public Library.—At a special meeting of the Edinburgh Public Library Committee last week, Councillor J. C. Dunlop said Sir William Thomson's opinion had been obtained as to the electric lighting of the building, and they were going to employ both the arc and the incandescent systems.

CURIOUS LIGHT EFFECT IN INCANDESCENT LAMPS.

DR. P. H. VANDER WEYDE has contributed to the *Electrical World* explanations of the effects referred to in our last issue. He says:—The phenomena described under this head are very familiar to all who have experimented with Geissler tubes in connection with the Ruhmkorff induction coil. The latter apparatus also gives alternating currents. There is a difference, however, between the latter and those produced by the alternate current dynamo, namely, that in the latter case the two currents are of equal strength, while in the induction coil the current produced in the secondary coil by the break in the primary is much stronger than the contrary current produced by the make of the contact. The cause of this is the self-induction in the primary, which at the break of the battery current increases its intensity. The reason is that every break induces a current in the same direction, while every make induces a current in the opposite direction; the latter will therefore counteract the battery current at its starting moment. Hence it is that the two alternating inductive influences are far from being equal, and consequently the two induced currents generated must be unequal also.

An incandescent lamp may be considered as a peculiar form of Geissler tube; it has also its highly rarefied air, with conducting wire reaching into the interior. If the outside of a Geissler tube is partially brought in contact with a strip of tin-foil, a saline solution, the hand or any other conductor, and then one of its conducting platinum wires be connected with one of the ends of the secondary coil of an inductorium, the other end of which is connected with the conductor, touching the exterior of the tube, the effects referred to are readily observed. I possess a vacuum tube more than three feet long, with no metallic connections, but entirely hermetically sealed, which, when taken in the hand at one end and moved with the other end in the neighbourhood of any alternating source of electricity of high voltage, will exhibit the most beautiful play of glow-worm, moonlight, phosphorescence, aurora borealis effect, or whatever it may be called.

In the case described in regard to the incandescent lamp, the saline solution surrounding the lower part of the lamp is a kind of external coating of a weak Leyden jar, which, according to the law of inductive attraction of opposite electricities, will predispose the carbon of the lamp, as well as the surrounding highly rarefied air, to admit readily the alternate charges in exactly the same way that a Leyden jar will readily absorb a charge when its exterior coating is connected with the opposite electricity; the copper wires dipping in the salt solution used as an external coating establishing this connection. When there is no outer coating to a Leyden jar, or if the outer coating is insulated, it cannot be charged; so, also, with the lamps in question, wherefore the conducting salt solution and its connection with the other conducting wire is essential. So is also the resistance R, the function of which is to increase the potential of the upper wire and the lower wire, or the interior of the lamps and the salt solution surrounding them.

It is a very old, and, alas! still prevailing error, not yet sufficiently rooted out, to ascribe all such and similar phenomena to the passage of electricity through the glass. If this were possible, it would involve the impossibility of charging a Leyden jar. Only static electricity of very high potential can, with proper and extra precaution, be made to penetrate glass, and if it is made to do so it invariably breaks it. Leakage is, therefore, out of the question, but it is simply the result of the rapidly alternating charges which the interior of the lamps is undergoing, and which, as explained above, can only be received in presence of a conducting exterior partially surrounding the lamps. This is further proved by the absolute necessity of every condition prescribed in the article, the omission of any one of which annuls the phenomena entirely.

A REPLY TO MR. A. T. SNELL.*

By F. J. SPRAGUE.

YOUR issue of August 31st, contained a paper entitled "The Sprague Motors at Richmond, Va.," by Albion T. Snell, which, while deprecating any intent of captious criticism, contains at once, with some interesting comments, several most unjustifiable conclusions, which a fuller knowledge of the subject would have led him to avoid. I do not think the question whether the English electrical engineers have anything to fear from their brethren on this side of the Atlantic is an important one in this connection. Whatever the self-complacent conclusions to which Mr. Snell may have arrived, it is quite within the possibilities that all competent electrical engineers can design motors of equal electrical and mechanical efficiency where no limitations are put upon them; but what is a matter of more importance is, how far the purely electrical deductions of the school or laboratory shall be subordinated to mechanical and commercial considerations; and if we are to judge by the relative advances made in England and the United States, I think the credit can be claimed for the Americans of dealing with these questions in a more matter of fact and pertinent manner. This may be acknowledged after due weight is given to the difference between English and American public spirit and enterprise, which same difference may possibly exist between electrical engineers of the two nationalities.

Novelty alone does not win in the United States, nor would a knowledge of the business done confirm the opinion that liberality of public spirit is the chief reason of success. One thing seems to be forgotten by an Englishman when discussing things American, and that is the fact that a newly developing business of special character is carried on, with New York as a centre, in places which may be as far away as Boston or Halifax, Smyrna or Trieste, or Constantinople is from London, and that it may take seven days of continuous travel to reach a point where work is being progressed. Does a liberal public spirit, may I ask, guarantee the success of an enterprise under such conditions? If so, the public spirit of our people in this widely diversified country is indeed liberal.

Turning to Mr. Snell's paper I find that he asks concerning certain curves published in a paper read before the American Institute of Electrical Engineers, "Why were they ever published in their present form, especially in view of the omission of allowances for material friction, self-induction, &c.?" These omissions being so apparent, it would seem that Mr. Snell's statement concerning them, that they are theoretical curves, might have been accepted as a fair explanation, and so treated. The curves are not, however, entirely theoretical. They are based partly upon experiments, partly on theory, and are useful for pointing out in a general way the approximate shape of certain characteristic curves of a motor under one condition of working, and some new uses to which such curves, assuming them to be correct, may be put. They have the same value that a theoretical steam diagram may have, and serve a purpose which is just as well attained for the layman as perfectly accurate ones, and, in fact, they must first be understood before the more accurate and elaborate curves can be fairly considered. If a strictly correct representation of a machine is to be made, much more numerous curves must be laid down than those suggested by Mr. Snell, and should be given in comparison with the theoretical ones. Many of his remarks are, however, interesting and to the point, and a more useful analysis of the motor would have been given had this method been adopted in conjunction with my own, and hence I may be permitted to make some comments on his criticism.

Referring to the diagram published in your issue of August 31st, the curve, O A, gives the average electromotive force of a particular armature when running at

a determined speed with an increasing and decreasing field and for constant and periodic work, and takes into account self induction (which lowers the curve) and the distortions set up by the armature current which would exist with the field coils in a particular relation; it can be obtained no matter how the field coils are excited so long as the ampere-turns correspond and are proportional to the armature current. This curve is of course a variable one when a large number of machines are built, and when the conditions of actual work are considered. Its flattening is due rather to scantiness of wrought iron and the use of cast iron in the magnetic circuit, and the length of the latter, as well as to the distortion set up by the armature, faults which commercial demands are largely responsible for.

The line of motor electromotive force in terms of the resistance and current should, of course, be slightly concave, because of the self-induction of the coils when leaving the brushes, or it could be made straight by varying the graphic unit of current.

We would have in practice: $C = \frac{E - (e + e')}{R}$; where

e' is the induction increment, its value depending upon the turns of the wire and the current.

The speed curve in terms of the current, E D C, does not in practice, for these particular machines, depart very seriously from that given within the actual limits of working, the speeds being, in one of the stock machines recently tested, and probably with fair accuracy, as follows:—

Ampères ...	10	15	20	25	30
Sprague curve ...	1,167	900	775	690	630
Actual ...	1,185	946	806	687	603
Snell's curve ...	967	860	667	600	540

being thus greater than my curve readings when less than 25 ampères, and less than these when greater than 25.

As regards the work curve, it is an ordinary practice in rough work to plot it for H.P. = $\frac{C e}{800}$ instead of $\frac{C e}{746}$, and then allow for any intersecting work curve an increase of 10 per cent. for material friction.

Absolute accuracy is not quite practicable, except in a laboratory. The expression H.P. = $\frac{C e}{746}$ is a true one, but

it does not of course represent the brake horse-power, since it includes useful work, air, commutator, journal and gearing friction, air fanning, work expended in generating eddy currents in the armature discs and binding bands, and in the pole pieces, the work of overcoming self-induction in the coils leaving the brushes, and energy expended in short circuited coils. The aggregate of the prejudicial classes of work would nearly bring the curve, O F C, to Snell's curve No. 4, but the ultimate reading of the characteristics of an intersection would be about the same as would be afforded by plotting the

work curve as H.P. = $\frac{C e}{800}$, and allowing an increase of 10 per cent. in the equation for car work, as was done; the former method is of course a truer indication.

The curve, O D G, giving the work of the motor in terms of its own speed, would, if plotted from E D C, corrected for self-induction, and O F C, corrected for material losses, be perfectly accurate, because it is simply based upon the facts indicated by these curves, and is plotted from transferred co-ordinates. Similar remarks are true concerning the curves of torsional effort.

Mr. Snell makes a most serious mistake when he assumes that these machines are designed to be run with the greatest normal output with half the maximum current; in other words, at about 14.5 H.P., and with over 50 ampères of current, and he points out the great loss which would exist under such circumstances.

He asks, "How long would a motor run with a furnace inside it?" and immediately afterwards says, "and note the car speed for this current is about three miles per hour, and so this must occur frequently." He then

* Copy of a communication sent to the London Electrician.

naively adds, "Well, the writer cannot explain this, &c." With the consciousness of this lack of explanation because of the knowledge that the assumption is entirely untenable, Mr. Snell should, it seems, have hesitated before jumping to hasty conclusions. True, it is said that the motors can for a short time work up to double their normal capacity, and considering the fact the line potential can be readily raised to 500 volts, and that for a few seconds under some very abnormal conditions, such as one motor being broken down on a very heavy grade or with a car off the track, a motor may be put under a most exceptionable strain, the remark is fairly true; but the assumption of Mr. Snell is, that because the car must be often running at three miles per hour this overload must be a normal condition of affairs. While I did not explain any particular method of governing these machines, I did say that they were commutated, and the key to the explanation lies in the difference between the English and my practice in street car motor government.

One of the things which are concerned is the total efficiency of the car circuit, which circuit includes the motors and the governing devices, but this is not all; the speed at which with a total determined car circuit efficiency series motors will run is of equal importance. There are three general methods of controlling motors: one (and it seems Mr. Snell's favourite) is to make use of external resistance, leaving the motor circuit undisturbed; another is to make use of both the external resistance and certain changes in the motor circuits; a third is to govern the motors entirely by variations in the arrangement of the field coils.

I have used all methods, but the last is characteristic of the Richmond machines. Their fields are wound with three sets of coils, varying in the number of turns, the cross-section of the wire, and the resistance; these are connected with a switch, so that when the motor is thrown into circuit the field coils are all in series and have a definite high resistance. The coils are then progressively commutated till they are finally thrown into multiple circuit and have a resistance of only one-ninth that at first existing. In this way a fairly constant field may be obtained for currents varying 300 per cent., and the motor be made to meet any required conditions, while for any particular arrangement of the coils many of the advantages and characteristics of the simple series motor are retained. The great advantage of this method is, that with any light load and with a given total efficiency of the car circuit the motor will run at a much lower and constant speed than if made with a fixed series field resistance and governed by a resistance coil; part of this governing can be accomplished by changing the armature circuits, but this method has such disadvantages that it was after a long trial in Richmond finally discarded.

As regards the Richmond motors, they are by no means perfect machines, and they have been called upon to do an abnormal amount of work, much more than was ever anticipated; the normal maximum load should be about $7\frac{1}{2}$ H.P., including friction, and they will develop this with about 18 amperes of current on a 400-volt circuit. The ratio of the motor electromotive force to the electromotive force existing at the terminals of the armature is then about 93 per cent. The average current through the machines is not over 5 to 8 amperes. When we consider that the machines have to be built to work up to 500 volts, if necessary, with the base frame in circuit, and hence necessarily well insulated, and in addition must be able to stand instant reversal with a heavy load on a 10 per cent. down grade, and were, furthermore, built to meet certain demands in regard to space, cost, &c., I have yet to hear of an English machine to meet like conditions more successfully.

Mr. Snell says that English practice would be to make a machine of equal capacity of about .65 ohm resistance, but it may be a pertinent enquiry to ask *what* English machine built for like conditions and service, to meet the same commercial demands and governed in the same way, and with a normal maximum brake load of $7\frac{1}{2}$ H.P. on a 400-volt circuit, is built to have a total

resistance of motor and regulating apparatus of .65 ohm. There is none. On the other hand, on the same page, Mr. Snell says:—"In ordinary English practice a motor absorbing 50 amperes, and, say, 100 volts, and running an 8-ton car at about three miles per hour, would have an internal resistance of .25 ohm, &c." There seems to be some confusion in the unquoted part of this statement, but if the motor has .25 ohm resistance on a 100-volt circuit, it will measure, because of the increased space taken up by insulation, somewhere about 4.5 ohms on a 400-volt circuit, a considerably higher resistance than that of the Richmond machine. No grade being given for these figures of Mr. Snell, they are supposed to be for working on an English tramway at level; one of the Richmond machines will easily run such a car under the same circumstances about 6 miles per hour.

As a matter of comparison between English and American machines, possibly the following figures will give Mr. Snell food for reflection.

One of our latest railroad machines designed to work on a circuit varying from 400 to 500 volts, and up to a normal capacity of the former potential of $12\frac{1}{2}$ H.P., has a resistance of about 1.4 ohms on the last step. The normal magnetic circuit outside of the gap is entirely of wrought iron, and the characteristic of the machine up to its normal load is very nearly a straight line and about equal to that of the best Edison-Hopkinson dynamo.

One of our earlier machines was a motor designed to develop 15 H.P. on a 220 volt circuit. A special committee from the Massachusetts Institute of Technology about a year ago tested one of these machines at 186 volts, a brake load of 21 H.P., and with about 60 per cent. current overload. Its commercial efficiency under these abnormal conditions was 78 per cent. Some of our standard machines have the following characteristics:—

Capacity.	Volts.	Armature resistance.	Shunt field resistance.	Ratio of resistances.
30 H.P.	220	.028	150	1,829
25 "	220	.058	140	2,414
30 "	440	.228	440	1,980

The ratio of electromotive force to the initial when under full load is, say, for the 25 H.P. motor nearly 98 per cent., and all these machines have a commercial efficiency of over 90 per cent.

I should be glad to know of any English machines, whether of 1885 or 1888 design, which leave much to be desired in the above in the matter of regulation or efficiency. I have given these figures to show the uselessness of Mr. Snell's self-complacent disparagement of American machinery, and to emphasise the fact that any just comparison of designs should be made under like conditions, and any other comparison, whatever its motive, is not only unfair but misleading. It will give me pleasure to show, possibly at an early date, the characteristics of the Richmond machines wound for storage battery work, and also the theoretical and brake curves of our heavier railroad and standard stationary machines.

A SYNTHETIC STUDY OF DYNAMO MACHINES.

(Continued from page 546.)

IV. LAWS OF MAGNETIC INDUCTION—(Continued).

THE curve, fig. 40, goes up to an induction of 18,500, this being obtained with a magnetising force of 200 per centimetre, but higher values for wrought iron have been obtained. Thus an induction of 19,330 has been obtained by Bidwell with a magnetising force of 340 and 19,820 with a force of 468. Hopkinson calculates that to produce an induction of 20,000 in the armature of the Manchester dynamo there are required about 590 ampere-turns per centimetre; and a higher induction than this is never required.

15. *Induction in the air gap.*—Returning to our apparatus, sketched in fig. 39, we may, in order to introduce an air-gap into the magnetic circuit, fix a stop on D which will keep C and D a certain distance apart when the latter is pushed into the frame. The length of the gap, that is its dimension parallel to the lines of force, we will assume capable of exact measurement, and this dimension, for a reason to be given by-and-by, is further assumed as very small compared with the diameter of the bar. We take a set of readings as before, D is pushed into the frame, and the magnetising coils, A A, are excited by a certain current. The magnitude of this current is observed, and while it flows the circuit is broken, D being simultaneously pulled out, and the resulting swing of the galvanometer needle from the annihilation of lines running through the test coil, B, duly noted. Corresponding readings of the current and galvanometer deflection being taken in this manner for different currents, the relation between the magnetising force and the induction is ascertained, and the result of introducing an air-gap is shown by the curves, fig. 42.

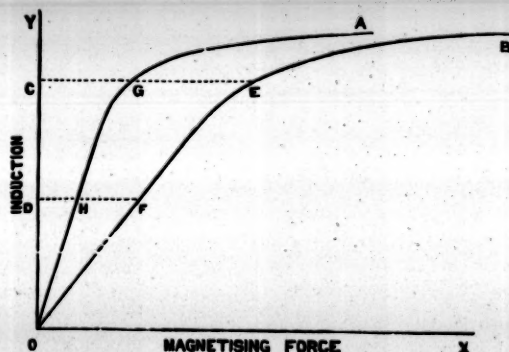


FIG. 42.

The line, O A, is the ascending curve of magnetisation for the iron alone, the induction being represented by ordinates and the total magnetising force by abscissæ. The curve, O B, is that obtained when the air-gap is introduced. Taking an induction, O D, we find that now a total magnetising force of D F is required instead of D H, as formerly, and it is obvious that H F, the difference between those two forces is required for the induction in the air-gap alone. Similarly, for an induction, O C, the total force required is C E, the part, C G, being required for the iron, and the difference, G E, for the

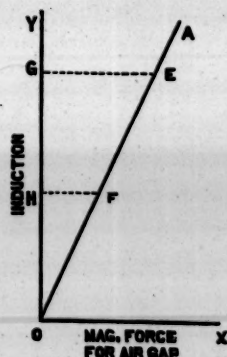


FIG. 43.

air. If we plot out the values of H F, G E, &c., for different degrees of induction as abscissæ along O X, fig. 43, we get a line O A to show the relation of the magnetising force to the induction in the gap. It is, as will be seen, a straight line, and we have established the simple relation that the magnetising force

required for a given air-gap is proportional to the induction through it. The magnetising force is also proportional to the length of the gap measured in the direction of the lines, and we might from these curves very easily determine the force required per centimetre length for different degrees of induction. This determination has been carefully made by several experimenters, who have found that the relation between the force and induction may be expressed by the relation

$$A = l \times 8 \frac{N}{a_1},$$

where A is as before ampère-turns, N the total lines of force, a_1 the cross section, and l the length of the gap. Suppose, for example, we wish to induce 300,000 lines in a gap of a centimetre length by 20 square centi-

metres cross section. Here $N = 300,000$; $a_1 = 20$; $\frac{N}{a_1} = 15,000$, $l = 1$, and therefore $A = 8 \times 15,000 = 12,000$. Having obtained the magnetising force required, both for the iron part and air-gap, we may, on the assumption that the lines are confined within the limits of the cross-section of the iron, write for the ampère-turns required for a magnetic circuit consisting partly of iron and partly of air the expression

$$A = L \times f \left(\frac{N}{a} \right) + l \times 8 \frac{N}{a_1}.$$

As an example of such a circuit, we may suppose the piece of iron 50 centimetres long, which served us in last article, to be bent into a ring (fig. 44), with a gap

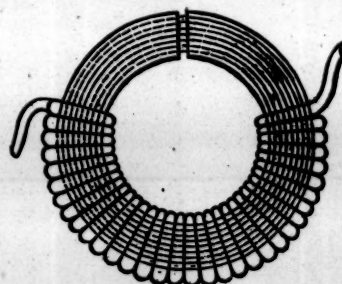


FIG. 44.

between the parallel ends of 1 centimetre. For the iron alone we found that a magnetising force of 1,250 was required, the induction being 15,000. For the air-gap we find that a force of 12,000 is required for a similar induction. For the total force required to induce 300,000 lines of force in this magnetic circuit of 20 square centimetres area, with an iron part 50 centimetres, and an air-gap 1 centimetre long, we require, therefore, $1,250 + 12,000 = 13,250$ ampère-turns. This result is considerably modified by the leakage of lines outside the area, to which we have assumed them as confined; but before dealing with the question of leakage, we will consider a few of the magnetic fields to be found in practice.

(NOTE.—The formula for the air gap is really $A = l \times 796 \frac{N}{a_1}$, '8 having been taken as sufficiently accurate for practical purposes.)

(To be continued.)

Telegraph Stores.—Tenders are required for the supply of the following articles, in such quantities as they may require, during six months ending June 30th, 1889, delivered carriage paid at the company's telegraph stores at York, for the North Eastern Railway Company: (1) Telegraph apparatus; (2) telegraph wire and line stores. Forms of tender may be obtained on application to Mr. Graves, Telegraph Department, York, and tenders must be sent to the secretary, at York, sealed and marked "Tender for Telegraph Stores," by noon on 27th inst.

**A REMARKABLE RUPTURE OF COPPER BY
THE ELECTRIC CURRENT.**

SOON after the formation of the Cannstatt Electro-technical Works, writes Dr. B. Nebel in *Centralblatt für Electrotechnik*, it engaged in the manufacture of glow-lamps. In these lamps, called from their inventor "Bernstein lamps," the carbon consists of a carbonised tube of woven silk. Whilst in the production of these lamps on the large scale the carbon is secured to wires of aluminium or platinum, it was fixed in the earliest lamps to rather thick copper wires by means of narrow slips of sheet copper, which were coiled up spirally, and acted, therefore, like springs. To ensure contact, carbon was deposited on the points of contact so plentifully that the greatest thickness of such a connection was from 4 to 5 millimetres.

To strengthen the whole, the copper wires running almost parallel in the neck of the lamps were bedded above and below, partly in blue and partly in white

together but they have since almost all fallen off, from shaking, but on the other wire there is a large tuft of such copper filaments. These threads have a copper colour only at a few spots; they are otherwise black like the upper parts of the copper wires, since during the burning carbon from the junctions has been deposited upon them and the glass globe is also turned slightly brownish. But this may also be due to the carbon strap, as it occurs in other glow lamps. The wire between the two places coated with enamel are smooth and have a shining surface resembling graphite in colour.

In the second lamp, which is still uninjured, the rupture of the wire is very plain. In the first place, the layer of oxide, like the bark of a tree, has been burst into pieces by the protruding threads of copper and pushed aside. The filaments are mixed together in confusion like a tangled cocoon. Both these threads and the torn wires have a pure copper colour, whilst the wires between the two deposits of enamel are un-



Points of connection
of the copper wires
with the carbon.

Magnified 435 times.

Ruptured copper.

Upper enamel.

enamel. As it soon appeared, copper is from various reasons unsuitable for the manufacture of glow-lamps, among other things the layer of oxide had a broken appearance; I therefore procured two such lamps for closer examination. Both lamps were arranged parallel, and were run at above the ordinary standard (50 v. and 1.2 a.). In this manner the lamps burnt with occasional interruptions several hours daily for half a year, till the carbon strap of one was burnt through directly above the point of connection with the copper wire. The other lamp continued to burn, though it was less urged than previously. But this burning did not last long, since I feared the lamp might soon burn through, as black spots were perceptible on some points of the carbon. Besides, the Cannstatt works were in the meantime burnt to the ground, so that no more lamps of this kind were in existence.

The copper wires were torn in a curious manner between the upper enamel and the connections with the carbon. This rupture had taken place in each lamp and in both wires.

In the lamp which was burnt through, the rupture had begun straight in one of the wires. There appeared some very fine filaments of copper lying loosely

affected, having their ordinary coating of oxide. The glass is rather of a deeper brown but is quite transparent, and there is no opacity in the neck.

In neither lamp is the slightest fracture in the wires between the enamels.

In order to give a representation of the phenomenon, I photographed a magnified image of the uninjured lamp.

Whether the electric current has passed partially from one broken part through the copper filaments to the other, which would involve an attraction or repulsion of this exceedingly fine copper tissue, I cannot decide. The chief quantity of the copper filaments proceed from those sides of the copper wires which are turned away from each other, as, on the other hand, in the burnt lamp the formation of copper threads begins on the inner side of one of the sides.

No such rupture of a metal by the electric current has yet been observed, not even in the case of lightning.

The Glasgow Exhibition Plant.—We beg to call attention to the advertisement of the Anglo-American Brush Corporation respecting the sale of this machinery.

A FEW POINTS ABOUT SPARKING.*

By L. W. SERRELL JR.

As the title might be taken by the romantic to refer to something occasionally mentioned in country ballads, which might seem out of place in a technical journal, I would say, both in justice to the editors and myself, that I refer merely to that troublesome occurrence which makes the commutators and brushes on our dynamos and motors so short lived.

Frequently our dynamo and motor tenders who take pride in keeping their machines looking clean and neat, and who try so perseveringly to keep the dull glossy look on their commutators which betokens an absence of spark, are irritated and harassed, after a half hour spent in trying to adjust their brushes, to find that they have not succeeded; or if they do succeed and walk away with an air of satisfaction regarding their work, they return a few minutes later to find their machine sparking as badly as ever; but if they are observant they will notice that the return of the spark is always accompanied by a change of load.

Why should this produce sparking? By a shifting of the neutral line? And if so, what should cause the neutral line to shift? Let us see.

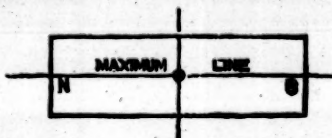


FIG. 1.

Suppose we have two bar magnets, fig. 1, placed one on top of the other with their north poles and their south poles together. The maximum line will be in the direction of their length, while the minimum line will be at right angles to the same. Fig 2 shows the

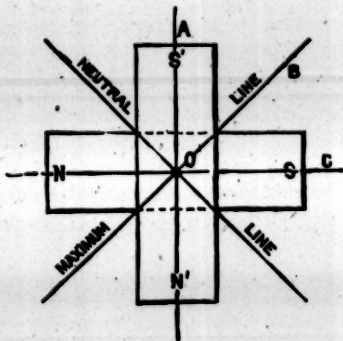


FIG. 2.

upper magnet rotated through an angle of 90°, in which case, if the poles be of equal strength, the maximum line will bisect the angle included between the magnets, the neutral line being at right angles to it, as before.

It is evident that if one magnet be weaker than the other, the maximum line will divide the angle A O C inversely proportional to the strength of the magnets.

Letting s = the induction of the magnet NS; s' = the induction of the magnet N'S', we obtain

$$s : s' :: \frac{1}{\angle BOC} : \frac{1}{\angle AOB} \text{ or, } \frac{s}{s'} = \frac{\angle BOC}{\angle AOB}$$

Now if N'S' were an electro-magnet, so arranged that its strength could be varied, the maximum line would change its position with every variation in the strength

of the magnets, and consequently cause a shifting of the neutral line.

The action is similar in our dynamos and motors. Fig. 3 represents a pair of pole pieces with their maximum and minimum or neutral line in the position

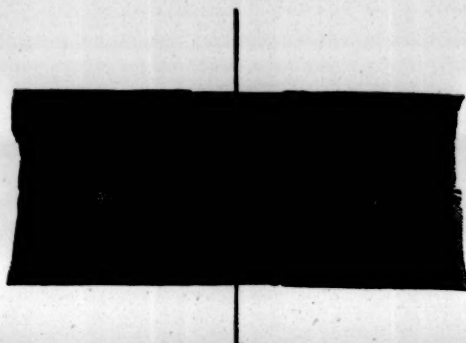


FIG. 3.

shown, and fig. 4 represents an armature ring with the brushes in the position shown, the poles being formed where the current enters, causing the maximum line to coincide with a line through the point of contact



FIG. 4.

of the brushes. Now, if the armature be placed between the fields, as shown in fig. 5, the line of maximum action will depend upon the relative inductions of the field magnets and the armature, and will assume a position approximating that shown in the figure, while the neutral line will be at right angles to it, as before; consequently the brushes should be adjusted to this position. The position which the resultant neutral line takes either forward or backward from the neutral line when the fields alone are considered is commonly known as the magnetic lead or lag.

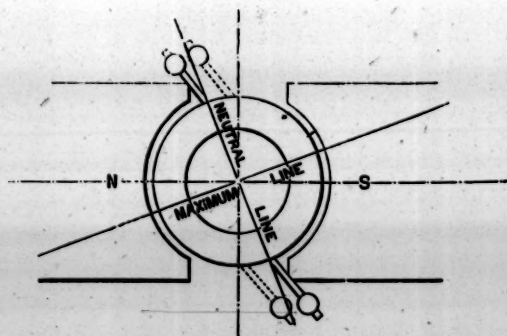


FIG. 5.

In constant potential dynamos and motors, when simply shunt wound, we have a constant field. The amperes of current flowing through the armature proportion themselves to the load upon the shaft, while the position of the neutral line depends upon the induction in the armature and is determined by the ampere turns of wire upon the same, being shifted with every variation of current which accompanies every change of load, hence we have a case similar to the permanent magnet and electro-magnet before cited.

The induction in the armature can only be diminished by using fewer wire turns upon the same, as a certain number of ampères must be supplied under a certain pressure to develop a given amount of power; consequently a machine properly designed, in which the sparking shall be a minimum, must have the strongest possible field which can be produced, while the iron in the armature core must have sufficient area of cross-section to conduct these lines of force below its saturation point. Under these circumstances we obtain an armature of low resistance, a machine of high efficiency, and excellent regulation.

In constant current dynamos and motors, in which the strength of the field is varied while the armature has a constant induction, it is much more important to make the wire turns on the armature as few as possible; for if we diminish the strength of the more powerful field magnets the ratio of the armature induction becomes greater and greater, causing a considerable rotation of the neutral line. Those who have seen dynamos and motors running on constant current circuits have always been impressed and frequently wondered why they should spark so much more than the incandescent machine. Why not build these machines with a constant field and regulate the volts automatically in the armature?

I am aware that many people believe that the position of the neutral line will be changed by a change of speed, but experiment proves that when the current in the armature is constant and the strength of the field remains the same, a change of speed has no effect upon the position of the neutral line.

By referring to fig. 5 we see that by shifting the brushes into position at the neutral line of the combination we also shift the poles of the armature, and consequently change the position of the line of maximum action, causing the neutral line to rotate still further back. This repeats itself each time we shift the brushes, so that, theoretically, it is impossible to place the brushes on the neutral line, but the fact that the brushes have thickness and cover quite a little of the periphery of the commutator makes it possible, if the machine be properly designed, to run with absolute freedom of spark under all variations of load within the capacity of the machine.

THE ELECTRIC LIGHT AND DANGER FROM FIRE.

SOME curious experiments have lately taken place in the laboratory of the Paris Society of Electricians as to the danger of fire from electric lighting. It is needless to insist on the interest which these researches present, principally as regards the lighting of theatres.

An experiment was made with a bare wire placed on a small board, and in part covered with a second board. This wire should normally conduct a current of about 4 ampères. The current was carried up to 40 ampères without the wood commencing to carbonise. For a current much more intense the wood took fire at the part where the wire is uncovered before burning the other part, where the want of air made inflammation slower. It is known that these accidents are avoided in a very efficacious manner in practice by the employment of fusible plugs.

In order to see to what extent the lamps themselves were capable of setting fire to strips and combustible bodies placed in their vicinity, the following series of experiments was carried out:—

1. The globe of an arc lamp (Cance system) was enveloped in several thicknesses of a light material (green tarlatan).
2. A 32-candle incandescent lamp was enveloped in the same way, the folds of the material being joined under the lamp by an India-rubber band.
3. A lamp of 32 candles was covered with a cotton cap of double thickness.

4. Another was covered with a calotte of black silk, which was in its turn covered with another of black velvet.

5. A lamp was surrounded by a layer of white wadding, off which the gummed surface had been taken.

6. Two lamps were covered with two layers of gummed wadding, white in one case and black in the other.

7. A lamp of 32 candles was placed in a vertical fold formed by an old theatrical decoration.

8. Lastly, a lamp of 300 candles was applied against an old decoration.

As regards the result, neither carbonisation nor exaggerated heating was produced in twenty minutes in experiments 1, 2, 5, and 7. At the end of a minute and a half the decoration in experiment 8 carbonised at contact with the glass and began to burn without flame. At the end of two minutes, after melting and carbonisation of the layers of wadding, the lamps in experiment 6 burst in, setting fire to the envelope. In about six minutes the velvet calotte was carbonised and began to burn slowly; the experiment was continued longer without breaking the lamp, but the glass was deformed. The cotton cap was partly carbonised at the end of ten minutes at the points of contact, but combustion had not then commenced.

M. Mascart, in giving his account of these experiments, the first of the kind yet held, we believe, on so complete a scale, has left to everybody the care of concluding, according to the application which he proposes to make of electricity, where the danger to be run begins and finishes. One cannot dispense, even with the new light, from the fire point of view, with measures of special prudence, which in each particular case will suggest themselves to the engineer.

OCEAN TEMPERATURES AND SUBMARINE CABLES.

A CORRESPONDENT sends us the following remarks in reference to Mr. C. Bright's communication in our last week's issue:—

"Mr. Bright's statement that 102·38 per cent. is at the present time 'quite an ordinary conductivity for copper intended for telegraphic purposes,' will come somewhat as a surprise to those engaged in the testing or manufacture of cables, as an average conductivity of 98 or 99 per cent. is generally considered an excellent result.

"I quite agree with Mr. Bright that too much reliance should not be placed on his proposed method of calculating the temperature of a cable by the variation in its dielectric resistance, and of using the result as a check on the temperature coefficient of the conductor—the said temperature coefficient might indeed come out somewhat higher (or lower) than that given for Dr. Mathiessen's standard; at any rate, it is not desirable that the 'fresh standard,' which Mr. Bright is anxious for, should have its temperature coefficient determined in this way.

"The 'practical examples' for calculating the effect of pressure on the dielectric resistance of a cable at depths of 2,000 and of 3,000 fathoms are very curious. At first sight, I thought that one or more of the 'incipient faults' must have disappeared from the cable in sinking through the last 1,000 fathoms, as, otherwise, the increase of resistance due to pressure should come out directly proportional to the pressure.

"According to the paper of the late Sir W. Siemens, referred to by Mr. Bright, it was to be expected that if the pressure at 2,000 fathoms increased the dielectric resistance by 123 per cent., the pressure at 3,000 fathoms would increase it by 184·5 per cent.; but instead of that, we are told that the increase jumps from 123 per cent. at 2,000 fathoms, to 889 per cent. at 3,000 fathoms.

"On looking into Mr. Bright's figures more closely,

the explanation of this discrepancy appears to be that in the example at 2,000 fathoms the pressure correction is applied to the resistance which the cable had at 75° Fah., whereas in the example at 3,000 fathoms the correction is applied, *but only as regards the last 1,000 fathoms*, to the resistance of the cable at 36° Fah.

"The numerical results obtained, and the inferences drawn, are in consequence a little mixed. I think the figures should stand thus:—

"For 2,000 fathoms:

Resistance of cable at 36° Fah. in megohms per knot = 6,737
Increase of resistance due to pressure = 123 per cent. = 8,287

Corrected resistance = 15,024

"For 3,000 fathoms:—

Resistance of cable at 36° Fah. in megohms per knot = 6,707
Increase of resistance due to pressure = 184.5 per cent. = 12,430

Corrected resistance = 19,137"

NOTES.

Electric Lighting at Exeter.—There has been some little controversy in the local papers with regard to the question of lighting the streets of Exeter by electricity. On the ground of economy the Corporation has fallen back on gas, and one of the local papers recently declared, *apropos* of the fact, that "Mr. Massingham would not bind himself down to light a given area of the city for a less sum than £1,486 per annum, whereas for the lighting of the same district by gas the Town Council pay but £666."

The Electric Light at Hove.—The Brighton Electric Light Company has made an offer to the Hove Commissioners in reference to the lighting of the Town Hall by electricity, and the matter is now under consideration by the committee.

Electric Lighting in Italy.—The city of Pallaenza, on Lake Maggiore, Italy, is now to be added to the list of cities using the electric light for public services, and being supplied from a central station. Last April a local company was formed, and the contract given for the work by Messrs. Malavasi and Dalgas, of Milan, was accepted, the latter firm being the Italian agents of Crompton & Co. Work was commenced in July, the plant consisting of three Cornish boilers, two engines by Ransome and Sims, Ipswich, and three dynamos driven from countershafting. The conductors are all overhead *bare* copper wires, attached to the fronts of the houses by iron supports carrying porcelain insulators; the circuits leaving the station distributing boards are 10 in number, the heaviest loaded having a diameter of 9.6 mm., and supplying light to the convict prison workshops. The governor of the prison is much pleased with the light, and has already requested an estimate for the distribution of the light all over the building. The whole of the work has been carried out by Mr. Chas. A. Baker, acting for the Italian firm, and on Sunday, November 11th, a most brilliant illumination was given for the public inauguration. The light, both arc and incandescent, gave great satisfaction, and the installation is now working regularly.

Electric Light in Bradford Mills.—The works of Messrs. Young & Co., of Valley Mills, Bradford, have been lit by electricity for several months past with great success. Messrs. Young are engaged in the manufacture of plushes and similar goods requiring great accuracy and art in their treatment. To cope with orders night work has been necessary, and at the beginning of the year an installation of electric light was fitted up by the Schmidt-Douglas Company. About 30 arc lamps of 2,000 C.P. are distributed over the works; current is supplied by a Shuckert self-regulating dynamo.

Church Lighting.—The lighting of the newly-established church at Tarbert Loch Fyne is at present under consideration. We understand the electric light is likely to be adopted, and if so it will be extended to the hotel and several of the larger shops. Correspondence is going on in the Rothesay local press as to the advisability of introducing the electric light in that favourite watering place.

Proportionate Value of Advice.—At the last meeting of the Paddington Vestry the Electric Lighting Committee recommended that they should be authorised to engage the services of Prof. George Forbes, F.R.S., to advise them generally as to the supply of this light, and to engage him at the cost of 100 guineas. Mr. Chas. Lee objected to the engagement of the gentleman named. After some further discussion, Mr. Overseer Jackson moved, as an amendment, that the services of Dr. Hopkinson to advise as above be engaged at the cost of 50 guineas. Mr. Wills seconded, and the amendment was put and lost, and the recommendation of the committee carried.

Electric Lighting in Vienna.—The first transformer installation in Vienna was put up jointly by Messrs. Ganz & Siemens at the terminus of the Western Railway now rather more than a year ago. Since then, *Industries* states, the station has been at work with completely satisfactory results. The dynamos and transformers are of the Zipernowski type. Having made this good beginning with transformer lighting in Vienna, Messrs. Ganz & Co. are now negotiating with a group of financial men, the object being to erect a large central station to the south of Vienna, and carry the current right into the heart of the town, in a manner similar to, but on a smaller scale than that proposed for the Deptford installation in London.

Hastings and the Electric Light.—The keen rivalry between the Sussex watering places is evidenced by the decision of the Hastings Town Council to renew the contract for the lighting of the principal part of the front line with 15 arc electric lamps, at a cost of the sum £150 and £200 per annum in excess of the sum needed by the gas company to provide 45 Whitehall lamps on the same portion of the parade.

The Electric Light in the Inner Temple.—That something like a row should disturb the placid calm of the Inner Temple is indeed astonishing, says the *Evening Post*, but that the disturbance should be caused by the electric light makes it even more wonderful. Yet it is true. Shade of Dickens! To think that the favourite haunts of little Miss Flite and the litigant lovers should be invaded by an army of workmen, and that a whirr of wheels should scare away the chirping sparrows and the twittering robins! People walking along the Embankment cannot have failed to notice a huge excavation close by the chrysanthemum show. It was intended to place on that spot the requisite plant for lighting the whole of the Inner Temple at a cost of fifteen thousand pounds. This was being done by the order of Sir Patrick Colquhoun, the treasurer, and the works have been suddenly stopped by order of the Benchers, who include on the Executive Justices Lopes, Grantham, and Pollock. It is stated that the treasurer had no authority to expend such a large sum of money without a Bench minute, and a meeting of the Benchers has been called to discuss the position of affairs. The Inner Temple Church and the Hall have for some time past been lighted by electricity, and the present installation was for the purpose of supplying barristers' chambers. Sir Patrick Colquhoun's action in the matter is not popular with the large army of the briefless, who contend that if the Benchers have more money than they know what to do with, they might, instead of laying on the electric light, which they do not require, make an abatement in their rents. The meeting will probably be a lively one, though, as the treasurer retires next month, it may possibly all end in smoke.

Philadelphia and the Electric Light.—The Philadelphia correspondent of the New York *Electrical Engineer* writes:—"A resolution was recently adopted in councils providing for the appointment of a special joint committee to investigate the electric light question. The city, the resolution stated, pays to electric light companies \$129,000 a year for 755 arc lights. This was claimed to be excessive, as the city, with a plant of its own costing \$300,000, could supply light to 2,500 or 3,000 lamps at an annual expense of \$90,000. The companies were also charged with furnishing only 1,200 candle-power to many of the lamps, while their contracts call for 2,000 candle-power. In view of these statements the committee was instructed 'to investigate and report, with such recommendations for legislation as may be decided necessary to remedy the evils presented and further the best interests of the city.' In speaking of the resolution Mr. Graham said that the electrical committee had considered the matter and had found that the plant would cost \$400,000, and the annual expense would be more than \$90,000. 'Still we don't get the light we are paying for,' he admitted."

Fighting Over the Electric Light.—A bitter fight came to a close recently when the Fort Wayne-Jenney Company received the contract for lighting the city of Bloomington, Ill. Three years ago the Thomson-Houston Company, of Chicago, installed a plant in the city on the understanding that the municipality should have the option of purchasing it. There was determined opposition to the purchase of the Thomson-Houston plant, and the Fort Wayne-Jenney decided to compete for the sale to the city of a complete outfit. The struggle became at once acrimonious, says the New York *Electrical Engineer*; charges and counter-charges were so numerous that the citizens became intensely interested in the contest, and two factions were formed. Representatives of each company were honoured by receptions by their respective partisans. Old friends quarrelled about the relative merits of the two companies, and the fight became decidedly unique. The Fort Wayne-Jenney obtained a majority in the council, and secured the contract at a bid of \$70,000. 240 lights will be supplied with current by eight dynamos. The lights will be suspended from mast arms.

Electric Light in Canada.—More interest is now manifest in electric lighting in Canada, according to the Montreal correspondent of the New York *Electrical Engineer*, than ever before. The Royal Electric Company has supplied a 250 light plant to the town of Granby; six hundred lights, including 12 arcs, are to be installed on the new Canadian Pacific Railway; Joliet is installing 30 arcs and 700 incandescents, and St. John's, P.Q., 30 arcs and 500 incandescents. The Royal Company is making vigorous preparations for the establishment of a 1,000 light alternating plant, and has the foundations under way for a 1,000 H.P. station.

Telephone Wires Underground.—The Bell Telephone Company, of Philadelphia, has commenced the work of putting its wires underground. Lead covered cables are laid in wooden boxes under the streets, and the wires are carried to large poles in the centre of each block, and from there they are distributed to the several subscribers in that block. A large trunk line is being laid in Market Street, from river to river. Other lines branch off north and south on each of the main streets. In nearly all the blocks small streets and alleys provide convenient centres on which to erect the distributing poles. By this system all streets will be freed of wires, as well as roofs of houses, and the network of distribution in back yards and small streets will be so small as not to be objectionable. The ordinance authorising the laying of these underground wires and erection of poles requires the removal of all overhead wires within five years, but the company expects to complete the work sooner than that.

Proposed Telephone Extension in Hampshire.—Mr. H. F. Lewis, General Manager and Secretary of the Western Counties and South Wales Telephone Company, has written to the New Forest Highway Board, declining to give facilities for a public station at Totton and Lyndhurst, in connection with the proposed extension of their telephone poles from Redbridge and Alum Green, as asked for by the Board, on the ground that it would involve the necessity of running 29 miles of extra wire at a cost of £300. In the course of the discussion which followed the reading of this communication, at a meeting of the Highway Board, the Clerk said that if they objected, Bournemouth would be precluded from having the telephone. The Chairman was of opinion that they might accede to the application on the understanding that if the company found their scheme sufficiently remunerative, they should give Lyndhurst and Totton the advantage of public stations. It having been decided to insert a stipulation to the effect that the telephone wires should not be of a less height than the lowest wire of the telegraph, a resolution was passed, consenting to the proposed telephonic communication between Southampton and Bournemouth on the express condition that the company should give to Totton and Lyndhurst a public call-room immediately it would pay the company to do so, according to the terms of their letter to the Board, dated October 31st, 1888.

United Telephone Company.—The *Financial News* writes very sarcastically of an article in a recent number of the *Electrician*, "by one 'J. Munro,' who appears to have been touring in the provinces, and while there, according to his own account, to have had, by pure chance, his attention drawn to the systems of telephony which have grown up." After remarking that "Our curiosity was excited by the fact, which became more and more evident with every paragraph, that the writer was really engaged, after the manner of a special pleader, in carefully traversing the recent report of our Commissioner on the development of telephony in the provinces, as compared with the primeval condition of things in London," our contemporary proceeds to show that "J. Munro" hails from Croydon, where also resides Mr. Brand, chairman of the United Telephone Company, and that on his pilgrimage he was accompanied by two of the leading officials of the company itself. The article is said to bristle with inaccuracies, and as a specimen the statement is quoted that there are no cables in Manchester over half a mile in length, and as a reply to this the length is asked of that between the Royal Exchange and Cornbrook. The writer is challenged to find in Edinburgh or in Dundee more than one or two wooden standards, and the suggestion that the streets and houses in Edinburgh are more regular than those of London is ridiculed. "Mr. Croydon Munro," continues the *Financial News*, "appears consumed with enthusiasm for the hideous 'derricks' with which London has recently been disfigured by the United Telephone Company. As coigns of vantage in a state of siege, from which sharpshooters, in bomb-proof security, might contribute to the defence of the city, these structures would be hard to equal, while, as combining the minimum of telephonic utility with the maximum of inartistic hideousness, they are certainly unrivalled. The three-strand wire, also, of which Mr. Munro appears enamoured, is generally regarded by experts as an Oxford Court superstition—a survival of a bygone age." Having declared Mr. Munro's defence utterly ridiculous, our contemporary proceeds to accord the United Company a small meed of approval for steps of progress tardily entered upon. It recognises the energy with which Mr. Brand labours in its interests, and says that since he boldly decided to override the obstructive policy of the managing director, Mr. Morgan, much has been done. The service has materially improved; most of the exchanges have been opened for night service, and the public has been granted access to the company's call offices. It hears also of progress in other directions, which is being initiated in the teeth of Mr. Morgan's protests.

Telephonic Enterprise in the South.—Great progress is being made with the trunk lines between the principal Hampshire towns. The Western Counties and South Wales Telephone Company has obtained all the necessary "way leaves" between Portsmouth and Southampton, and can proceed with the erection of wires as quickly as it pleases. It is anticipated that by the end of January Southampton will have been placed in telephonic communication with Brighton.

The Telephone at Bermuda.—The importance of telephonic communication is becoming recognised in our colonies and dependencies as well as in the Mother Country. The last mail from Bermuda brought the information that at length telephone wires have been stretched right through the islands. At present, however, the only places on Ireland Island that have availed themselves of the telephone are the Officers' Club and the Co-operative Stores, but it is considered pretty certain that the Admiralty will very shortly connect the Dockyard and the Superintendent's residence, and place the colonial and military authorities in other parts of the island in communication with each other.

Newmarket and the Telephone.—At a meeting of the Newmarket Local Board last week, the clerk read a letter from the South of England Telephone Company asking permission to erect overhead wires for the purpose of a telephone exchange in the town. It was unanimously resolved not to allow overhead wires to be fixed.

The Pacific Cable.—The *Ottawa Daily Citizen*, in a leading article on the proposed Australian Pacific Cable, says:—"The principal Australian colonies have now been heard from, and it will no longer be possible for anyone to deny that New Zealand, Victoria, Queensland and New South Wales are each in favour of the cable to Vancouver, and warmly desirous of the most intimate relations of trade and friendship with Canada."

Telegraphic Extension in North Devon.—The little town of Combe Martin has now its telegraph office, thanks in a large measure to the persistency with which its vicar (the Rev. H. W. Toms) has memorialised successive Postmaster-Generals. The wire is laid on from Ilfracombe, and passes through Berrynabor, where a telegraph office has also been established. A yearly sum of £66 has been guaranteed to the department from Berrynabor and Combe Martin.

Electric Locomotion in Paris.—In "Paris Day by Day," the *Daily Telegraph* correspondent says: "Pending the definitive installation of the 'Hansom cab' in our midst, the latest novelty in the way of vehicular conveyances is a commodious tramcar, which, propelled by electricity, plies up and down the Avenue de la Grande-Armée, between the Arc-de-Triomphe and the Porte Maillot. This is the first innovation of the kind, so far, introduced into Paris, and it seems likely to prove a success. Some time ago a series of experiments was made with electric tramcars on the ground at the rear of the Palais de l'Industrie, and the trial was more than a nine days wonder. It says much for the spirit of enterprise which prevails in this metropolis that this invention should already have become an accomplished fact on one line. This, by the way, is not the first time that the broad Avenue de la Grande-Armée has been utilised for the practical ventilation of novel systems of locomotion. A few years ago steam tramcars were running at frequent intervals between the Triumphal Arch and Courbevoie, on the further side of the Seine. Their use was, however, discontinued, it being found that horses were frightened by the engine, several serious accidents being the result. The same objection cannot, however, be made to the electric tramcar, which glides along without any noise, and is thoroughly under control. If electricity be eventually adopted here as a motive power on all the tramways, it has, at least, been discarded for the lighting of the streets."

Electric Light in Night Firing.—The *Weiser Zeitung* gives an account of an interesting series of trials recently made in Germany for testing the value of the electric light in night firing. The targets were placed at a range of 400 metres from the riflemen, while the electric light generator was situated 200 metres behind the firing party. The apparatus consisted of a steam engine, a dynamo mounted on a carriage, and a projector. The result of the experiments was that nine shots out of ten struck the targets. The apparatus can only be placed *hors de combat* if a shot should strike and break one of the carbon supports, but this is an extremely improbable contingency. The illuminating waggon, as it is called, has been attached to the Prussian Engineers, and will be used in the attack and defence of fortresses. Its weight is too considerable to admit of its being extensively used in the field.

The Westinghouse Electric Company.—The Westinghouse Electric Company, Pittsburgh, Pa., has recently issued a catalogue descriptive of its alternating system. The covers, attached by copper staples, are beautifully embossed. A dragon bearing in his mouth an incandescent lamp which sheds its rays in every direction, is represented on the front cover, resting upon the first letters of the name which has done so much to make America famous the world over. As represented in the illustration on the first page, the company's factory covers over two entire blocks. "What and where" is the index. A little fairy, whose wand is tipped with a lamp at incandescence, sits watching some lights in a field filled with wild flowers. On the same page is described the history of the growth and development of the alternating system.

Electric Locomotion in Scranton.—Within three months the flourishing city of Scranton, Pa., of 100,000 inhabitants, will not have a car propelled by horses. The electric road (Thomson-Houston) has given such satisfaction that every horsecar line in the city is being equipped with an electric system. "Screenings," fine anthracite coal, costs 10 cents a ton.

Effect of Static Charge on Incandescent Lamps.—"Anac" writes to the *Electrical World*: Among the several articles that you have recently published in regard to the effect of static discharges on incandescent electric lamps, I see nothing exactly similar to a case that recently came to my notice. Most of the trouble occurred at a socket suspended by a flexible cord about 18 inches from a 6-inch leather belt, not crossed. Six lamps were used up in an afternoon run of about 2½ hours. On examining the lamps I found in each a small hole at a point on the bulb that would be touched by the bend of the filament if drawn to one side. The hole was about large enough to admit a cambric needle, and was not caused by softening of the glass, but by fracture, and in some cases I found small bits of glass inside. On approaching a good lamp to the belt the filament was immediately pulled toward the side of the lamp next the belt, the bend resting close against the glass; this effect I suppose was due to the glass being electrified by proximity to the belt and attracting the filament, the same as in the familiar experiment with pith balls. A touch of the hand to the belt was sufficient to cause the filament to fly back to its normal position. Two or three other pendants hung near belts have also contributed toward our collection of 16 punctured lamps. My remedy, for which I am indebted to Ben. Franklin, was to run a wire from the nearest steam or gas pipe to within about one-half inch of the belt, ending in a number of fine wires (from a bit of flexible cord), thus discharging the electricity as fast as generated. Since putting up my miniature lightning rods I have had no further trouble.

The Royal Society.—At yesterday's meeting, Prof. Ewing, F.R.S., and Mr. W. Low were to read a paper "On the Magnetisation of Iron and other Magnetic Metals in very Strong Fields."

Smoking Concert.—Of those firms which believe in encouraging athletic development amongst their employes, not the least conspicuous is the electrical firm of J. B. Verity and Sons. The "Verity" football teams have met with a large amount of success, and the establishment can also put a fairly strong cricket side into the field. To aid the funds of the athletic club, which comprises the various branches of summer and winter sport, a smoking concert was held at the Horse Shoe Hotel, Tottenham Court Road, on Monday evening. Mr. J. B. Verity, jun., was in the chair, and there was a large attendance of members and friends. A capital and lengthy programme was gone through to the unbounded satisfaction of those present; so greatly was the concert enjoyed that there is but little doubt that there will be frequent repetitions during the season.

City and Guilds of London Institute Old Students' Association.—The balance-sheet and report of this Association for the session 1887-8 has been sent us, and we gather from them that the Association is in a flourishing state. There is a substantial balance in hand; the members number 142, and excellent papers are periodically read and discussed. The quality of these papers may be judged from the remark of Prof. Perry, one of the examiners, who, referring to those of the past session, said: "The papers were all such as would be gladly accepted by the Councils of the various Societies before which papers on such subjects are read." Of the ten papers of 1887-8, the following six were on electrical subjects:—"Diseases of Dynamos," by Prof. Silvanus P. Thompson; "Static Electricity," by L. Davidson; "The Manufacture of Incandescent Electric Lamps," by F. G. Ansell; "Distribution of Electricity in Networks of Conductors," by W. E. Sumpner, B.Sc.; "Artistic Electric Lighting," by H. Swan; and "Installation Breakdowns," by Reginald J. Jones. The last-named paper obtained the medal of the Association for its author.

The West Indian Cable.—At a meeting of the Jamaica Legislative Council on October 16th, a discussion arose over the vote of £2,000 to the West India and Panama Telegraph Company as cable subsidy. Mr. Craig strenuously opposed the vote, and read extracts from several letters, in which it was shown that the company charged \$2 50c. for a message of 10 words between Jamaica and Santiago de Cuba, and they charged for transmission over the submarine cable to Havana \$6 70c., while they only paid \$3, thus pocketing \$3 70c. by the charge. The hon. gentleman proposed that the Government should lay a line from the island either to Santiago de Cuba or Colon. The tariff for messages from the latter place to Europe has been reduced to \$1, and he thought that the company should be prepared to reduce the cost of telegrams between Jamaica and Europe in the same ratio. It was arranged that only half of the subsidy should be paid for the present, while communication was to be opened up with the chairman of the company, with a view to having the telegraphic rates fixed upon a more equitable basis.

"Guinea Pigs."—In an article under this heading in the *Financial Times*, the subject of which is Mr. Jabez Spencer Balfour, the Metropolitan Electric Supply Company is severely criticised. According to our contemporary, the Whitehall Electric Supply Company, which the Metropolitan Company was formed to take over, is, to a considerable extent, synonymous with Mr. J. S. Balfour, and, that gentleman being a director of the new company, the *Financial Times* anticipates friction between the two companies as a consequence of "an ingenious device for allotting to the Whitehall Company certain founders' shares which carry with them privileges and rights enough to sink a far stronger ship than the Metropolitan Electric Supply Company."

The Storm.—High winds and gales have prevailed during the past week, and for some time telegraphic communication was seriously interrupted, especially in the North and in Scotland, the delay between London and Edinburgh and Glasgow being close upon five hours. Press messages were not forwarded, and the Scottish evening papers were as a consequence deprived of their usual complement of news.

Suggested Electric Tramway in Bournemouth.—At a meeting of the Bournemouth Commissioners the week before last, a letter was stated to have been received from Messrs. J. C. St. Aubyn Angove, notifying the intention of a company to apply to the Board of Trade for a provisional order sanctioning the construction of a tramway from Bournemouth to Boscombe on the east, and from Bournemouth to Poole on the west. They urged, in requesting an expression of opinion from the Commissioners on the subject, that the proposed tramway would be a great convenience to the travelling public. The gauge would be a narrow one of three feet, as used in the colonies and elsewhere, while the width of the carriages would not be above 5 feet 6 inches. It was hoped to utilise electricity as the motive power. A plan was forwarded with the letter explaining the route which it was proposed to take. A motion having been proposed, referring the question to a committee, Mr. Rebbeck said that the matter had been discussed before, and they were quite agreed that it would be the greatest mistake possible to allow the tramway to pass through the town. He therefore moved, as an amendment, that the permission requested should not be given. Mr. Beechey seconded, and stigmatised tramways as great nuisances. Eventually, by a majority of one vote, the matter was referred to the committee.

Department of Science and Art.—Mr. W. Crookes, F.R.S., has presented to the Department of Science and Art a collection of 68 radiometers and similar instruments for permanent exhibition in the Science Galleries of the South Kensington Museum. They illustrate the steps by which Mr. Crookes was led to the construction of the radiometer, and to the production of motion and of phosphorescence by streams of electrified molecules in high vacua. Many of the instruments are of the greatest historical interest. Among them is included the first radiometer, with many others, which are described in Mr. Crookes's papers in the *Philosophical Transactions* of the Royal Society. Others are of considerable value, as they contain collections of diamonds, rubies, &c., for the exhibition of the phenomena of phosphorescence. Nearly all are in working order, and will be of great use in illustrating lectures to students in the Normal School of Science at South Kensington. The collection will be on view in the galleries of the museum in Queen's Gate as soon as the necessary stands and fittings are completed.

The Insulation of Conductors.—We have heard, but we cannot guarantee the correctness of the statement, that the insulating material to separate the concentric tube conductors for the Deptford central station is paraffined paper. If this is correct, only those who have had long experience in the manufacture of condensers can appreciate the difficulties with which Mr. Ferranti will have to contend in practical work. One may admire the pluck of this young engineer, but his prudence, if the above be correct, is scarcely to be commended.

The New Gas.—A very interesting exhibition is now being given at No. 6, Lombard Court, London, of a new method of treating gasoline, by which a pure mixture of oxygen and hydro-carbon is produced, which burns with a better light than the gas in ordinary use, and gives off no impurities. At the address named any visitor will be courteously shown the apparatus, and, we think, cannot fail to be convinced that the system has considerable merit.

Street Lighting.—The lighting inspectors of the parish of Merton, Surrey, invite tenders for lighting the public lamps by gas, oil, or other means. Further particulars may be obtained by applying to Mr. W. W. Lambert, High Street, Merton.

Removals.—The offices of the West African Telegraph Company, Limited, have been removed from 98, Cannon Street, E.C., to Winchester House, 50, Old Broad Street, E.C.

The offices of the *Eastern, Australasian, and South African Journal of Commerce*, and of the *Periodico de Comercio de Espanol, Mejicano y Sud Americano* have been removed to Intercolonial House, 131, Leadenhall Street, E.C. The new premises contain large reading, reference and conference rooms for the convenience of merchants and others visiting London, and provide a centre from which all information upon matters of British, Colonial and Intercolonial trade may be obtained free of charge. We may add that the *ELECTRICAL REVIEW* is filed at Intercolonial House.

Messrs. W. T. Goolden & Co. notify that they have removed their offices from 2, Victoria Mansions, Westminster, and their works from Westminster and Halifax, and in future their only address will be Woodfield Road, Harrow Road, London, W.

Brokerage.—The decision of Mr. Justice Kay in the Faure Accumulator case that the payment of brokerage on the placing of shares is illegal has come as somewhat of a shock in City circles, and the financial papers are by no means in accord with the ruling of the eminent jurist. *Money*, for instance, says: "For years past it has been the custom, hallowed by time, for a new company to allow to brokers, through whom applications for shares have been sent in, a fair and equitable brokerage upon the amounts allotted to their clients, the amount, in the case of honest, *bona fide* companies being about the same as these brokers would have charged their clients for the purchase of shares in a going concern, or on a £10 share about 2s. 6d. For years these brokerages have been paid by companies of high class with directors of unblemished character, and have been accepted by brokers and bankers of standing and repute without the thought that they were guilty of any moral wrong, much less that they were infringing the law. So thoroughly has it been understood that payments of this kind were not only legal, but in every sense of the word proper, that four out of five prospectuses contain a clause to the effect that all expenses of the company up to allotment will be defrayed by the promoters, *except brokerage*, the latter, by implication, being a legitimate charge upon the funds of the company itself. Yet this time-honoured custom of the City is by Mr. Justice Kay declared to be all wrong." Finally, *Money* thinks the decision of the judge not only bad law but bad sense.

Wood Casings for Electric Wires.—One after another the large firms of timber merchants are turning their attention to the demands for woodwork arising in connection with the wiring of houses for the electric light. We now learn that Messrs. J. F. and G. Harris, who carry on an extensive business in mahogany and general timber, and are well known as manufacturers of mouldings, are giving special attention to these casings. Having an extensive connection amongst builders and wholesale shippers, which enables them to purchase the raw material on a very large scale, and having facilities for putting in hand large quantities at a time, there is no doubt this firm is in a favourable position to compete with others in the matters of quality, price, and promptness of supply. An improvement is introduced by Messrs. Harris in the design of these covers which will be duly appreciated by all who regard neatness of appearance. The inner edges of the lid pieces are finished with a beading which has the effect of making the join invisible.

"Curing by Electricity."—The following choice bit of intelligence is taken from the *Montreal Herald* of the 25th ult.:—"Dr. Lennon last night gave a series of experiments in curing diseases by animal electricity. His system is a very simple one, no preparation or machinery being necessary to complete the cure. He simply passes his hands down the patient's head and face and thence down the body to the feet thus imparting electricity to the patients, completing the cure or alleviating the pain. Parties afflicted with numbness, deafness, rheumatism and pains and aches of almost every description were cured, and gave their testimony at the close to that effect. The doctor's theory is as follows: The cause of disease is a mystery, the same as anything spiritual. For example, take a man who has the ague, you see his teeth chattering and you say he has the ague, but what is the ague? You cannot weigh it, nor can you see or handle it. There are inward vital forces in the body that work irrespective of the will, and so long as the inward forces are at a normal standard we have good health, and when these forces degenerate, we get sick. Now drugs have forces that counteract the inward forces of disease, and it is the force that electricity imparts that drives out the pains." Dr. Lennon is evidently a worthy disciple of Mesmer.

Electricity in the Service of Man.—On Wednesday evening, at the Town Hall, Poplar, Mr. W. Lant Carpenter, B.A., B.Sc., M.S.T.E., commenced a series of three lectures on this subject, Sir John Bennett presiding on the occasion. The lectures are delivered under the auspices of the London Society for the Extension of University Teaching and the Gilchrist Trustees.

The Electro-Harmonic Society.—The amateur concert (ladies' night) of this society takes place on Friday evening next. The programme, which can be seen on page 8 of our supplement, is, we think, an advance upon that of the previous similar occasion, and we trust that members and friends will muster in goodly numbers to listen to the efforts of those who have so kindly consented to conduce to the evening's enjoyment.

Moth-Catching by Electricity.—Mr. G. V. Hudson describes in the *Entomologist* the "largest assemblage of moths he has ever seen in New Zealand." They were flying round an electric light suspended from the yard-arm of the steamship *Aorangi* in Wellington Harbour.

Novel Medical Consultation.—The Canadian Pacific Railway telegraph line was united with the ocean cables on Sunday afternoon, the physicians at Victoria, Vancouver, being thus enabled to consult with Sir Andrew Clark in London about the case of Lord Ennismore, who is lying dangerously ill of typhoid fever. Questions of temperature, pulse, respiration, &c., were asked and answered, the operation in each case requiring only a few minutes' time. This novel consultation continued for three hours.

Good Business.—The telephonic line from Paris to Brussels, the cost of which was returned the first year of working, gives an annual revenue of about 120,000 francs. By the application of the Van Rysselberghe system upon this line, the same wires are used simultaneously for telegraphic and telephonic messages, which further increases the return. This good result is partly due to the indisputable superiority of the telephonic apparatus which the Belgian telegraphic administration provides for the use of the public. The apparatus, which is on Dejongh's system, and manufactured by Messrs. Moulon, of Brussels, has been recently awarded the gold medal of the Grand Concours. It is intended to replace the old apparatus of the same kind. The Dejongh instruments require no regulation, and transmit speech with incomparable power and clearness. They are already adopted in Spain, Italy, Egypt, Mexico, and the Argentine Republic, as well as in the English and Dutch colonies.

Legal.—An action has been tried before Mr. Justice North to decide whether there was or was not a partnership existing between Messrs. Winfield & Co., and Messrs. Crompton & Co. in 1882, and subsequently. The plaintiffs said a partnership had been talked about, but was never settled upon; the defendant alleged that a deed of partnership was signed in September, 1882, and that no verbal arrangement was afterwards come to with regard to subsequent business transactions, which were all carried out under the name of the Crompton-Winfield Association. Mr. Justice North reserved judgment.

Electrical Purification of Quartz.—Electricity, states the *Carpenter and Builder*, is gradually being introduced into ceramic operations to purify quartz and kaolin from oxide of iron. The powder to be operated on is placed in a hopper, whence it falls into a receiver rotating rapidly on a vertical axis. This receiver is surrounded by powerful magnets of triangular section. The purified powder then falls into a second receiver, and after undergoing a similar purification in this, it is, as a rule, ready for use. The cost of this process is small, and it is stated that, owing to its employment, substances can now be used which were formerly rejected on account of the amount of iron contained in them.

Harpers.—We have received catalogue No. 6 from Messrs. Harpers, of Aberdeen, giving particulars and prices of belt pulleys, rope pulleys, gear wheels, shafting, pedestals, fixings, castings and their other manufactures, with a portrait of the compiler modestly placed on the last page. The catalogue is a model of arrangement and is beautifully got up and printed. We also had the pleasure of receiving some time since the contents of this catalogue printed in sheet form, glazed and mounted on strong cardboard for hanging on the wall. In our haste to adorn our office wall with this work of art, we regret that at the time we omitted to acknowledge its receipt. Both in the book form and as a sheet the catalogue will be found of value to every one interested in the work of the machine shop.

Sheffield Society of Engineers.—On Saturday evening, by special permission, the members and associates, about 40 in number, met for the purpose of inspecting the machinery and plant used in the production of the electric light, by the Sheffield Electric Lighting and Telephone Company, Limited. Mr. Fred Tasker conducted the party, and explained in detail the construction and arrangement of engines and dynamos, storage batteries, &c. The main driving engines consist of a horizontal tandem compound, and high pressure coupled cylinders of 40 H.P., driving three "Thomson-Houston" dynamos, giving collectively a light equal to 300,000 candles; also a Phoenix dynamo, sending a current to the storage batteries, which can be given out again when the engines are standing. At 8.15 the members adjourned to the Central Telephone Exchange. The arrangement for establishing communication between subscribers was courteously explained by the attendant in charge. A very instructive and enjoyable evening was spent.

Overhead Electric Wires.—In reply to Mr. Bradlaugh, in the House of Commons, on Thursday last week, Sir M. Hicks-Beach said that no overhead wires for the purpose of electric lighting had been sanctioned so far. He could not make any definite promise with regard to future applications on the subject with reference to the metropolis; but certainly he should not be disposed to sanction such applications. Mr. Brunner asked whether the right hon. gentleman had power to prohibit the erection of such wires in the metropolis. Sir M. Hicks-Beach: That is a question I would rather not answer at present.

Electrical Automatic Box Company.—The *Financial News* understands that proceedings are now pending by one of the largest shareholders against the Electrical Automatic Box Company, Limited, for the purpose of recovering the money subscribed by him on the ground of misrepresentations in the prospectus.

Electrical Fire Engine.—Prof. S. S. Wheeler's electrical fire engine is described by the *Scientific American*. It is intended to be worked by the current of an electric light wire, which can be tapped for temporary service anywhere that it is wanted. Each engine will carry on a reel some 500 feet of insulated fine copper wires, bound together, cable fashion, so as to equal a No. 3 wire, for transmission of the current. As "it is a good deal easier to squirt electricity than to squirt water," the engine, it is intended, shall be placed near the fire and the electric connection made as is convenient. The powerful current of an arc light wire will not be required, that of the ordinary incandescent light circuit, which is much lower in intensity, being amply sufficient to run the motor of the engine. The great advantages claimed for the electric fire engine are that it can be instantaneously started up at full speed; that it is much lighter than a steam fire engine of equal power; that it costs one-third less; that it is safer and easier of control; that it is noiseless in its operations; and that it is economical. Where there are no electric light wires in the street to be tapped, it will not be impracticable to run it by means of storage batteries charged from a dynamo at the engine house or at any other convenient established point.

Effect of Electric Currents on Plants.—Professor E. Wollny, of Munich, has experimented on the effect of electric currents of different intensities and characters on the growth of plants. Small plats of about four metres square were provided, and were separated by plates penetrating 25 centimetres into the soil. On the two sides of one of these beds, plates of zinc were sunk, the dimensions being 30 centimetres by two metres. They were connected by an insulated wire, with five Meidinger cells in the circuit. Another enclosure had an alternating current constantly sent across it, while in a third there were simply buried a copper and zinc plate connected above the earth by an insulated wire. The three enclosures were therefore subjected to different conditions—to a weak direct current, to a comparatively strong direct current, and to an alternating current. Several specimens of grain, potatoes, carrots, &c., were planted, and were subjected to the action of the currents until they reached maturity. Comparing them with plants grown under ordinary conditions, the result to which Prof. Wollny is led is, that electricity, whether under the form of continuous currents of different intensities or of alternating currents, exerts no influence on the vegetation of plants.

Overhead Wires and Fire.—On the night of the 6th inst. a fire broke out in a six-story warehouse in Boston, and caused a loss of fully \$50,000. It is said that the loss would not have been nearly so great had not the mass of electric light wires in front of the building on Atlantic Avenue interfered so seriously with the work of the firemen. These wires made it impossible for the men to stand on the ladders without receiving shocks from the electric fluid. One fireman came in contact with an electric light wire while he was standing on a ladder, and received a severe shock, which necessitated his removal to the City Hospital. The injuries of other firemen from the same cause was slight. At last the electric light companies shut off the currents of electricity, and then the firemen went to work with a will, and soon had the fire under control.

The Society of Arts.—At the meeting on Wednesday next, Col. Gouraud will lecture on the phonograph. Sir Frederick Bramwell will preside, so a lively and interesting evening may be anticipated.

Anglo-Australian Telegraph Service.—Referring to a statement that "the extremely unsatisfactory state of the existing cable communication between England and Australasia is injurious to trade, and would be a source of great danger to Imperial interests in time of war," the Secretary of the Eastern Extension, Australasia, and China Telegraph Company writes:—"The existing communication with Australia was established by the Eastern Extension Company in 1871, without subsidy or assistance of any kind from the Colonies or the Imperial Government, and subsequently, when the importance of telegraphy became more fully realised, and a duplicated system a public necessity, not because a single line was unequal to the transmission of the traffic, but in order to provide against the interruptions inseparable from a single line of cables, the Colonies of Victoria, New South Wales, South Australia, and Western Australia agreed to give the company a subsidy of £32,400 per annum for 20 years, to enable it to duplicate the cables between India and Port Darwin. Since then the telegraphic communication has been very seldom interrupted, a result due to the duplication, and, in some sections, triplication of the cables, and to the fact that they are laid for the most part in shallow water, and are, consequently, repairable at almost all seasons of the year." After mentioning the exceptional circumstances under which communication has been interrupted, the writer adds:—"In order to further strengthen the system, the company are about to lay a third cable from Java to Australia, which, by working with the Western Australian landlines, will give the colonies the advantage of an alternative land connection *via* Perth and Eucla to the existing overland line between Port Darwin and Adelaide. Consequently, the colonies will be provided with a complete and efficient telegraphic service by the existing system, not only equal to the transmission of a much larger traffic than it now carries, but enjoying the immense advantage of being under English control, and worked by English operators throughout its whole length." With regard to communication in time of war, it is pointed out that "while the route between Australia and Java and Europe is incomparably the most secure and easily protected in time of peace, it would be the most surely and easily safeguarded in time of war, inasmuch as it is one of the sea routes most frequented by the mercantile marine, and would, therefore, be the special object of the vigilance and care of the Royal Navy."

Oil Ships' Lights.—In the *Standard* of yesterday appeared the provisions of the new Petroleum Bill and an account of the blowing up in Bristol Harbour, with loss of life, of the ketch *United*, of Jersey, laden with 310 barrels of petroleum spirit. The disaster is supposed to have been occasioned by a light coming into contact with the oil itself. It is evident from this calamity following so closely upon that off Calais, that there is very great danger attached to the working of these vessels, and that the electric light only should find a place on board.

The Influence of Joints in the Magnetic Circuit of Dynamos.—M. Larroque has recently carried out a series of experiments on this subject, which, although apparently not so exact as those of Professor Ewing and Mr. Low, lead to the same conclusions. It is therefore confirmed that the magnetic resistance of a joint diminishes as the pressure between the two surfaces increases, and that for the same applied pressure the resistance of the joint decreases as the total induction is increased. M. Larroque adds to this that in a practical machine, when the iron approaches saturation, the influence of mechanical vibration is so marked, that the field is equivalent to that of a magnet of the same size and form without any joint.

Edison in Brooklyn.—The Brooklyn Aldermen have passed an ordinance giving the Edison Company the right to do business in that city.

The London Chamber of Commerce.—A friend has called our attention to what he believes to be a miscarriage of justice. He is of opinion that it was resolved that the chairman of the Electrical Trades Section of the London Chamber of Commerce should have been elected from without the working committee, but in this he is in error. A resolution was passed at the general meeting of the section giving the committee power to elect their officers, if necessary, outside that body. That resolution, however, did not imply that the committee must necessarily select its officers outside itself. It was passed, we believe, with the object of giving the committee the faculty of selecting a member of the House of Lords, if desirable, or of electing some leading member in the trade, supposing that that gentleman were not elected on the committee. When, however, the committee came to elect its officers it was found that it included sufficient representatives to permit of the selection of a good chairman, and, after some discussion as to the names of members of the Upper House connected with the electrical trade, it was decided that it would be preferable, in the interests of the section, to have a chairman who could follow the meetings of the council of the Chamber closely, and to leave to the vice-chairman the Parliamentary interests of the section.

The Society of Telegraph-Engineers and Electricians.—We received an abstract of a paper set down for reading last night before this society, by Mr. Henry Edmunds, on his system of electrical distribution. Our space will not allow us to touch upon the matter this week; but, from a glance at the abstract, it does not appear to vary greatly from the paper by the author on the same subject read before the Bath meeting of the British Association and reported in the *ELECTRICAL REVIEW*.

Gilbert's Shackle Ball.—A lengthy letter has come to hand, but too late for insertion this week. It will find a place in our next issue.

Glasgow Police Signals and Alarms.—The Lord Provost and the magistrates of Glasgow recently witnessed at the Exhibition a demonstration of a system of police signals and alarms given by Messrs. R. Feldtmann & Co., Glasgow, agents for Messrs. Bolling and Lowe, London, the representatives of Mr. Rust, the patentee. The main feature of the system is that numbered signal boxes, containing telephones and automatic signalling instruments, are placed at proper distances from each other on every policeman's beat, and are electrically connected with the police station, and from them the policemen can automatically transmit different messages and register them at the station houses, such as a request for aid, for an ambulance or waggon, &c.; or they can converse by telephone with their officers at the station houses, and citizens can also readily summon police assistance from any signal box. Examples were given of the various signals and messages that can be transmitted by the apparatus, and the completeness of the system was generally admired.

Physical Society of Glasgow University.—An ordinary meeting of the above society was held in the Natural Philosophy class-room on Thursday last week. Mr. M. Maclean, M.A., F.R.S.E., president, in the chair, Mr. A. Tanakadate read a paper on "The magnetic funnel, and some of its applications." After defining the term "magnetic funnel," the author described the general characteristics of such surfaces, and proceeded to investigate several particular cases, such as the case of an imaginary simple magnet consisting of two unlike centres of action; and several cases of electric circuits. The author then pointed out how the result could be applied to avoid electrical disturbances in magnetic measurements, and how it afforded a means of finding the approximate centres of action of magnetic systems which, he showed from his own researches, depended on the strength of magnetisation.

OFFICIAL RETURNS OF ELECTRICAL
COMPANIES.

Crosley Telephone Company, Limited.—The annual return of this company, made up to the 24th October, was filed on the 29th ult. The nominal capital is £100,000 divided into 5,000 A, 12,500 B, and 2,500 C shares of £5 each. The shares taken up and calls made are as follows:—607 A, £5 called; 120 B, £1 called; 350 C, £5 called. The calls paid amount to £4,905.

Dalmatia Mining and Electric Power Company, Limited.—The statutory return of this company, made up to the 4th September, was filed on the 11th September. The nominal capital is £60,000 in £1 shares. 10 shares have been taken up and 5s. per share has been called. The calls paid amount to £2 10s. Registered office, 3 and 5, Queen Street, Cheapside.

Protean Battery Syndicate, Limited.—The statutory return of this company, made up to the 6th September, was filed on the 12th September. The nominal capital is £5,000 in £10 shares. 73 shares have been taken up and the full amount has been called thereon. The calls paid amount to £650 and unpaid to £80. Registered office, 119, Palmerston Buildings, Old Broad Street.

Luther Hanson & Co., Limited (Electricians).—The statutory return of this company, made up to the 16th October, was filed 25th ult. The nominal capital is £7,500 divided into 900 ordinary and 600 deferred shares of £5 shares. 293 shares have been allotted, and upon 193 the full amount has been called. 100 shares are disclaimed and cancelled, and 600 deferred shares are also cancelled. The calls paid amount to £950 and unpaid £15. The office of the company is at the offices of Mr. James Duff, Barum House, Barum Top, Halifax, York.

PROPOSED PACIFIC OCEAN CABLE.

A MEETING, convened by the Pacific Telegraph Company, Limited, was held at the Cannon Street Hotel yesterday (Thursday), to consider a proposal submitted by the Pacific Telegraph Company to the Governments of Great Britain, Canada, and Australasia, for the laying of a cable from Vancouver Island to Australia. The Earl of Winchester presided. The following resolution was submitted to the meeting for approval:—

"That in view of the unsatisfactory state of the existing telegraphic communication between Great Britain and Australasia, this meeting most strongly approves of the proposal of the Pacific Telegraph Company, Limited, to lay a cable across the Pacific Ocean from Vancouver Island to Australia, touching at Hawaii, Fanning Island, Samoa, Fiji, and New Zealand, and to reduce the tariff from Great Britain to Australasia to 4s. per word, and that this meeting, believing that the laying of such a cable would be of great benefit to commerce in time of peace, and a safeguard to Imperial interests in time of war, trusts that Her Majesty's Government will do all in their power to facilitate the laying of such a cable, especially by obtaining the necessary soundings with as little delay as possible."

The CHAIRMAN said what was desired by those who convened the conference was to obtain an independent expression of opinion from commercial men as to whether it was not high time something was done to improve the telegraphic communication between this country and the colonies of Australasia. They were there simply as men of business to set forth their own interests as traders. They were not there to attack other people, nor even had they failed to realise or recognise the great debt they owed to those who had been the forerunners in this matter of communication. They were there simply to ask themselves and to answer the question whether the means of communication at present existing were sufficient, whether they were safe, and whether they were as cheap as they ought to be. With regard to the present means of communication, he thought they could scarcely be called cheap, indeed almost prohibitive was a more applicable term. Such a tariff as 9s. 8d. per word, if not absolutely prohibitive, must lead to a very restricted intercourse indeed; it led, as he knew, to the compression of messages to such a point that they were often unintelligible. With regard to the second essential of communication, the continuity of the cable, he must point out that no less than three times during the last four months the telegraphic communication between this country and Australia had been entirely interrupted. Then, with regard to its safety, they had to consider that there were two states in which the world could be—peace and war—and it would not be too much to say that in the event of war the existing cables would

be absolutely defenceless. The fact that the present lines of communication passed through the Isthmus of Suez rendered them liable to be cut at any moment by a belligerent force. Egypt had been the battlefield of the world in other generations, and might be again in our own, and nothing was more certain than that, if we were involved in war with a great European Power in Egypt, means would be found to cut the means of communication, which we should be utterly unable to defend, and we should be in the position of being for something like six weeks entirely cut off from communication with Australia. That was a contingency which, from an Imperial point of view, we could not regard without the gravest apprehension. The proposal now made was that a line of cable should be laid from Vancouver to Australia, touching at Hawaii, at Fanning, Samoa, and Fiji. Of course, it would connect with the existing strong and very dependable lines of communication between this country and Vancouver. It was fair to say that there were so many lines across the Atlantic at present, that, having in view the interest which the United States must have, as well as ourselves, in maintaining them, it is totally impossible for all those cables to be destroyed in the event of war. Then, through Canada, entirely on British soil, they had a line which would connect them with Vancouver, affording a very dependable, and, what was more, an entirely British line. The remark had been made that they were venturing on unknown depths in the Pacific; but the consensus of expert opinion was that it was a perfectly practicable route. There was already a cable in existence, the Pernambuco cable, which was only 200 miles less in length than the longest stretch they proposed to lay, and from the experience gained with that and other cables, it was certain that there was less danger to cables laid in great depths than to those laid in shallow waters; both from insects and from the currents which caused attrition. The bottom of the Pacific, they knew, was, generally speaking, and except at the islands, where the cables could easily be protected, composed of a kind of soft mud which was favourable to the life of the cable. Then at the bottom of the ocean the water was colder than in shallow seas, which was an additional factor in favour of the cable. Another great point in favour of a deep-sea cable was the fact that it would be extremely difficult, if not impossible, in time of war to destroy the cable. Referring to the great advantage to be gained by the reduction of the tariff from 9s. 8d. per word to 4s. per word, the Chairman said it would not only give the immediate advantage of cheapness, but would probably revolutionise the business arrangements between England and the colonies, very much to the advantage of business, and would lead probably to a large development of trade between the Western shores of the Pacific and our colonies in Australasia. With regard to the guarantee that had been asked from the Governments, that guarantee was not to be in the nature of a subsidy, but only a guarantee that the Governments would, in proportions arranged between themselves, use the cable to the extent of £75,000 a year. With regard to the Imperial nature of the problem with which they had to deal, they knew how trade followed the flag. Figures told them that their trade with Australasia was about £8 per head, while the trade with the United States and other nations only amounted to about 8s. per head. Therefore, it was obvious that they ought to encourage trade within the limits of the British Empire. This would be very much facilitated by a line of cable wholly within British control. In the event of war breaking out it would be possible to mass a great quantity of troops at Vancouver, the greatest coaling station on the West Pacific, and throw them into India or Australia in a shorter time than would otherwise be possible. After referring to the further scheme of running a line of mail steamers over the same route, the Chairman said that Canada, after the great exertions she had made in the building of the Canadian Pacific Railway, which afforded a great Imperial route to our Eastern possessions, deserved well of the Mother Country. She was deeply interested in this scheme, and he was glad to know that he should have the pleasure of calling upon Sir Donald Smith to move a resolution in favour of it. The Australian colonies were also interested, and this was the only great public question in which they were in agreement. This cable would put us in possession of a means of opening out the Pacific as it had never yet been opened out to British trade and British influence, and would assist in diverting the volume of traffic to a British instead of an American centre, and we should be in possession of a line of telegraphic communication which would be at once a second string to our bow and also a cheap, safe and continuous line of communication between England and her dependencies.

Sir DONALD SMITH moved the resolution quoted above, and said the scheme was worthy of all the support which could possibly be given to it by the commercial community of London, by the people of England, and by the colonies. He was intimately connected with Canada, and whilst he was not authorised to speak for the Government of Canada, he believed that both the Government and the people would go heartily into it. The promoters of the scheme did not wish, he believed, to oppose any other companies, and the other company chiefly concerned should bear in mind that the greater the facilities given in respect to railway, postal and telegraphic communication, the more largely they were used, and the greater the profits derived. He saw no reason why this should not turn out a very profitable enterprise.

Mr. DOXAT seconded the resolution, and said the Eastern Extension Company could not have realised the enormous check to business caused by the 41 days interruption of communication of which they spoke so lightly.

Mr. BLACKWOOD, as an Australian by birth who was British in every instinct, spoke strongly in favour of the scheme as a means of strengthening the bonds between the Colonies and the Mother Country.

Mr. McEWM, who said he had just come from Vancouver, and that he was one of the originators of the Atlantic Cable 30 years ago, said this was the best thing he had ever heard of, and he was convinced that they could make the line pay at even 2s. a word. He advised them not to trust to Governments for help, but to go through with the thing themselves.

Mr. WESTGARTH having testified to the enormous expansion of trade and commerce in Australia, the resolution was put and carried unanimously.

The Hon. HAROLD FINCH HATTON, secretary of the company, then proceeded to answer *seriatim* the points raised in the circular of the Eastern Extension Telegraph Company, published that morning. He could understand the objections to the new scheme on the score of its entering into competition with an existing cable system if they proposed to lay their cable over the same ground as was occupied by the Eastern Extension Company; but they were about to open up entirely a new hemisphere where, at the present moment, commercial relations between the two greatest commercial empires of the world were entirely non-existent, owing to there being no cable communication, and if they came into competition with the Eastern Extension Company's system at the end of their journey, it was due to the fact that the world was round and nothing else. The whole question was one of national insurance. The taxpayers of this country and the taxpayers of Australasia and Canada were asked to contribute what every one must agree was a very moderate sum merely as an insurance for securing their Imperial communications. He contended that the present means of communication were most unsatisfactory in time of peace, and must always be absolutely indefensible in time of war. The Eastern Company spoke of triplicating the cable from Java to Australia, thus affording to Australia and the Colonies a complete and efficient telegraphic system enjoying the immense advantage of being under English control and being worked by English operators throughout its entire length. That was a statement calculated to mislead. A glance at the map would show that the existing system passed through Spain, Malta, Egypt, Arabia, India, the Malay Peninsula, and Java. Was that a system which could with any fairness be described as being completely under British control? Having dwelt upon the increasing frequency of the breakdowns in the existing cable, the speaker said news had come that morning that the Perim-Suakin cable had again broken. He did not think it was fair to claim that the numerous breakdowns this year were abnormal, and not likely to occur again. Mr. Finch Hatton continued at some length to deal with and traverse the statements in the Eastern Extension Company's circular, and concluded by pointing out the great necessity from an Imperial point of view of increased means of communication, and stating that this scheme offered as perfect a telegraphic service as it was possible to obtain. He sincerely trusted Her Majesty's Government would not be backward in following the example set them in this matter by Canada and Australia.

A vote of thanks to the Chairman closed the proceedings.

CITY NOTES, REPORTS, MEETINGS, &c.

Eastern Telegraph Company, Limited.

An extraordinary general meeting of this company was held at Winchester House, yesterday, under the presidency of Sir John Pender, to consider a resolution to increase the ordinary share capital of the company from £3,800,000 to £4,000,000, by the creation and issue of 20,000 new shares of £10 each.

Mr. Geo. Draper, the Secretary, having read the notice convening the meeting.

Mr. Burt, the Solicitor, read the resolution to be submitted to the meeting, which was as follows:—That the ordinary share capital of the company be increased from £3,800,000 to £4,000,000, by the creation and issue of 20,000 new shares of £10 each; that such new shares shall rank for dividend equally with the existing ordinary shares as from 30th September, 1888; that such new shares be in the first instance offered at the price of £12 per share (£2 per share premium) to the members of the company registered on the 22nd November, 1888, as holding 10 or more ordinary shares—holders of from 10 to 20 ordinary shares to be entitled to one new share, and holders of more than 20 ordinary shares to be entitled to one new share for every complete 20 ordinary shares held; that all new shares not accepted by the members entitled thereto, and £2 per share duly paid thereon, be allotted and disposed of by the board of directors as they think expedient; that the amount of the new shares and premium be payable as follows:—£2 per share on or before the 2nd December, 1888, £5 per share on or before the 15th December, 1888, £5 per share on or before the 15th January, 1889; that upon completion of the payments the premium of £2 per share be carried to the general reserve fund; that the directors may require interest at £10 per cent. per annum on any instalment (after the first £2 per share) in arrear; and that, subject as aforesaid, the details, terms, and

conditions of the issue be such as shall be determined by the board of directors.

The Chairman, in moving the resolution, read a comparative statement showing the progress of the company since 1872, when the last increase of capital took place, consequent on the amalgamation. In 1872 the company had 24 stations, 8,862 miles of cable, owned or rented 1,200 miles of land line, and possessed two cable repairing ships; the capital was £3,397,000, and the gross revenue was about £376,922 per annum. In March, 1888, the total capital was £5,900,000, the gross revenue was £850,971, the cable mileage 22,405, and there were 64 stations. The increase in the capital since the amalgamation was therefore £2,503,000; £700,000 had been applied to the reserve fund, and a new ship, costing over £45,000, had been paid for out of the ships' fund. They had at the same time added three ships to their fleet. This showed a marvellous growth in 16 years, a growth which had been facilitated by their policy of keeping ahead of public requirements. The object of the increase of capital which the shareholders were now asked to sanction was to duplicate the South African system. It would be recollected that in 1879, when the South African cable was under discussion, it was thought that the Eastern Company should not bear the whole responsibility of that cable; other companies agreed to share the responsibility, and the Eastern and South African Company was formed. But the entire management and working of the cables was in the hands of the Eastern Company. The Eastern and South African Company had grown to such large proportions, and the traffic had so greatly increased, that it now became absolutely necessary that the system should be duplicated. This they had resolved to do by carrying a cable down the west coast of Africa instead of the east coast, so that they would have a completely alternative route direct from London, and their wires would entirely encircle Africa. There were two other companies with cables on the west coast of Africa, the African Direct and the West African, but the Eastern Company, for all practical purposes, had the management of both. The money to be raised was to be expended in purchasing shares which the Eastern and South African Company was going to issue, by which arrangement this company would become practically the proprietors of that system; £300,000 in debentures of the South African Company would also be required, but the cost of the whole system would be about half a million, and those debentures would be issued to the Eastern shareholders *pro rata*. Beyond the provision made by the resolution they found that after giving everyone his proportion of the new shares, according to the resolution, there would be 1,900 shares left, and these it was proposed to issue to the shareholders holding less than 10 shares, so that even the holder of one share might have one new share.

The Marquis of Tweeddale seconded the resolution, which, after a few enquiries had been made and answered, was unanimously agreed to.

Blackpool Electric Tramway Company, Limited.

The following report of the directors will be presented to the shareholders at the fourth annual general meeting, to be held to-morrow.

The directors have pleasure in submitting to the shareholders their fourth report and the accompanying statement of the accounts of the company for the year ending 31st October, 1888. The revenue account shows a balance in hand for the year of £1,834 10s. 9d. Adding to this £22 19s. 6½d. makes an available amount of £1,857 10s. 3½d., of which the directors recommend the following disposal:—Dividend of 4 per cent. on the paid up share capital, £301; depreciation and reserve fund, £1,000; balance to next year's account, £556 10s. 3½d.; £1,857 10s. 3½d. The depreciation and reserve fund, with the addition of £1,000, as above recommended, will be £2,159. The number of passengers carried this year was 711,218, against 618,527 last year. The number of miles run during the year was about 90,000. The retiring directors are Messrs. Horsfall, Bickerstaffe and Broadbent, who are eligible for re-election. The board regret to have to record the retirement during the year from the directorate of their esteemed colleague, Mr. Joseph Moseley. Mr. Broadbent's services as managing director have been secured again for the coming year.

South of England Telephone Company, Limited.

An extraordinary general meeting of this company was held at Winchester House, on Thursday, when several alterations of a minor character were made in the articles of association.

United Telephone Company, Limited.—This company notifies that dividend warrants will be sent out on the 7th proximo for an interim distribution of 5s. per share.

TRAFFIC RECEIPTS.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending November 16th, 1888, after deducting the fifth of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £4,405.

The West India and Panama Telegraph Company, Limited. The estimated receipts for the half-month ended the 15th November are £2,314, as compared with £2,025 in the corresponding period of 1887. The July receipts, estimated at £2,331, realised £2,402.

AMERICAN NOTES.

By DAS TELEPHON.

In the REVIEW of August 17th and of September 28th of this year, there appeared lengthy notices of the famous magneto-telephone invented by Dr. S. D. Cushman. I wish again to impress upon your numerous readers at home and abroad the fact that in a judgment rendered by Judge J. Blodgett on July 21st, 1888, is to be found the following sentence:—

"My conclusion from a careful reading and consideration of this mass of testimony is that Dr. Cushman did make with the aid of W. P. Cushman and B. T. Blodgett in Racine during the summer of 1851, a device containing magnetic coils through which spoken words could be and were transmitted at short distances."

For a semi-complete description of the device, I refer your readers to page 359 of the REVIEW of September 28th last. I send to you a printed copy of the decision of the judge, on page 11 of which you will find the words above quoted.

No one can deny that the instrument described is a magneto-telephone, a perfect counterpart of the magneto-telephone described by Prof. Bell, and claimed to be his invention in his famous U. S. patent of March 7th, 1876, and English patent of November 9th, 1876. The eminent counsel for the Bell Company during the trial of the case proved that the Cushman instrument was a perfect fac-simile of the Bell magneto-telephone and the presiding judge so held.

The facts judicially established are:—Firstly, Dr. Cushman made a magneto-telephone by means of which spoken words were transmitted in 1851; and, secondly, that the magneto-telephone described and patented by Bell on March 7th, 1876, is identical with that of Dr. Cushman of 1851.

To Dr. S. D. Cushman must be given the honour of being the first inventor of an electrical speaking telephone. His name must be placed at the head of the list of inventors of the speaking telephone.

The list will be:—

Dr. S. D. Cushman	...	...	1851
Charles Bourseul	...	...	1854
Philip Reis	...	...	1861

These are the only true inventors and discoverers of the art or way of reproducing speech by means of electricity. There are followers of these great discoverers, and there is one who claims to have been the first inventor of the magneto-telephone. I refer to Prof. Alexander Graham Bell, but, alas! for his claim. Here is a damning record against his pretensions.

The third claim in Bell's first U. S. patent is the combination, with an electro-magnet, of a plate of iron or steel, or other material, capable of inductive action, which can be thrown into vibration by the movement of surrounding air or by the attraction of a magnet.

The use in a magnetic telephone of a vibratory disc with an electro-magnet dates back to Bourseul's invention, of which the following description was published in 1868 in Paris:—

"Suppose a man speaks near a movable disc, sufficiently flexible to lose none of the vibrations of the voice, and that this disc alternately makes and breaks connection with the battery, and at the other extremity of the line the current enters an electro-magnet, which attracts and repels another vibrating disc of size and quality identical with the former, this disc will execute the same vibrations."

It is evident that the apparatus above described is identical with that named in 3rd claim of Bell's patent of January 30th, 1877.

These lines are from a translation into English published in New York, 1872, under the title "Wonders of Electricity," by J. Baile. The damning evidence is that Prof. Bell had this book in his possession before he applied for his patent, and referred to it in his address before the Society of Telegraph-Engineers, in London, in October, 1877.

I send you drawings of Dr. Cushman's magneto-telephone, as exhibited in court. Fig. 2 represents the device used in 1851, by which speech was transmitted.

In order that the natural desire, which is found in all human-kind, to see, either the person, or the likeness of the person, who has done some great deed, I send you a photograph of Dr. Cushman, also his autograph, which some people say shows the character of the man. I will add that Dr. Cushman is in his 70th year.

Your readers have no doubt learned from the REVIEW of September 28th last that the learned judge ignored the facts which he says were established, and held that Cushman's device operated as an acoustic telephone. A petition for a rehearing has been made to the same learned judge necessarily, and it cannot be expected that he will, as Dogberry did, cry out, "write me down for an ass."

THE PROPOSED ELECTRIC TRAMWAY IN THE NEW FOREST.

In view of the project to establish an electric tramway between the Lyndhurst Road Railway Station and Lyndhurst, efforts are being made by those who view the scheme with disfavour to induce the South-Western Railway Company to run a branch line over the route in question. A meeting was held last week of those favouring a railway in preference to a tramway.

Colonel MACLEAY, J.P., who first suggested that the railway company should be approached, objected to the electric tramway scheme on the ground that its benefits would be very small,

that the line would be incomplete, and, moreover, because he should like to know a little more regarding the gentlemen who composed the syndicate, whether they were men of substance and able to carry out their project in the event of the necessary permission being given.

Mr. W. F. RAWNSLEY said that as the railway would cost at least £1,000 per mile, the company would not expend their money unless they saw some chance of getting a return for their outlay.

Mr. G. S. COXWELL said that an electric tramway would cut up their roads and increase the danger arising from accidents. He moved for the appointment of a committee to memorialise the London and South-Western Railway Company to make a branch line, and in the event of their refusal, to approach some other independent company.

Eventually the motion was carried almost unanimously.

It is considered that the probability of the railway company acceding to the request of the meeting is exceedingly remote, more particularly as some years ago their proposal to run their line through Lyndhurst met with such bitter opposition that it had to be withdrawn. As it also is in the highest degree improbable that any other company would adopt a scheme likely to prove so unremunerative, the people of Lyndhurst and the neighbourhood, who are suffering severely through being out of touch with the railway, would do well to accept the bird in hand, which is certainly worth any two which may be in the bush.

On Monday at a meeting of the New Forest Board of Guardians, Mr. SCOTTER, general manager of the South Western Railway Company, was stated to have written intimating that the latter would have no objection to the construction of the proposed electric railway and would, if convenient, permit it to enter the railway station at Lyndhurst Road, provided satisfactory terms were arranged.

IRONMONGERS' EXHIBITION.

THIS Exhibition, which opened on the 12th and remains open till the 24th, is the first attempt made to hold a trade exhibition limited to the productions of the various branches of the iron and metal trades. From the fact of the catalogue containing introductory articles on "Coal Gas as adapted for Lighting, Cooking, and Trade purposes," and on "Electricity and how to make use of it," one may infer that it was intended that exhibits illustrating these subjects should have formed the leading features of interest. So far as cooking by gas is concerned, this may be said to be the case, as there is a fairly representative show by some of the leading makers of gas stoves. Gas lamps and burners are not so fully illustrated as might have been expected, but of gas engines, although the number is limited, the Stockport, the Griffin, and the British are all interesting exhibits. A good show is made at the stand of the Stockport, where 11 Brush-Sellon arc lamps are run direct from a Victoria dynamo driven by an 8 H.P. engine of this make, others of smaller power being also shown at various duties. At the adjoining stand, Atkinson's patent Cycle engine is shown driving some incandescent lamps, and in another part of the building Messrs. Dick, Kerr & Co. have five specimens of the Griffin engine, of different powers, one of 6 H.P. being employed to drive a Gulcher dynamo supplying 5 arc lamps, and another of 2 H.P. to run 27 incandescent lamps from a Leeds dynamo. These glow lamps, though run direct, are perfectly steady and free from the pulsation usually caused by the beat of a gas engine. The principal exhibits relating to electricity are those of Messrs. Appleton, Burbey & Williamson, The General Electric Company, and Messrs. Pressland & Co. These consist of the usual display of domestic accessories, such as bells, alarms, lamps, and lamp fittings. At the General Electric Company's stand there is in addition a variety of medical batteries and a very large display of gaslighters. At many of the stalls an effective display is made with incandescent lamps, some in Lea's globes being particularly striking. These lamps, numbering from 25 to 30, are supplied by Messrs. Appleton, Burbey & Williamson, from a machine driven by a small steam engine at Mr. Hindley's stall. Mr. S. Elliott, of Newbury, exhibits samples of his wood casings for electric wires; and samples of wire made by Messrs. Ramsden, Camm & Co., of Brighouse, are shown by their London agents, Messrs. G. W. Share and Co. At two or three stalls are to be seen some excellent work in hammered iron, in the way of artistic fittings for candles, gas, and electric light, most of them being apparently of foreign manufacture. Mr. Keen, of St. Leonards-on-Sea, exhibits his Patent City

Post and Lantern surmounted with a Brush lamp. The post has steps which can be closed or opened as required, and when closed are flush with the post. When the man ascends he opens the steps, and when he descends he closes them. By this adaptation a long ladder is dispensed with, the use of which would be almost impracticable in the City of London, &c. A T-branch is fixed at the top of the Post, and on each branch iron standards or uprights are screwed, which conduct the cables from the post to the arc lamp, and on these a cast-iron ring is fixed, and so constructed that the lantern can be easily secured, and as easily removed when required. All the parts of the Lantern are perfect in working, and so adjusted that it is shadowless, and the insulation good.

THE HOUSE-TO-HOUSE ELECTRIC LIGHT SUPPLY COMPANY, LIMITED.

A circular from which we made the following extracts is being brought before the notice of the residents of Brompton, Earl's Court, South Kensington, and neighbourhood.

CENTRAL ELECTRIC LIGHTING STATION, WEST BROMPTON

(Adjoining the West Brompton Station of the Metropolitan District Railway Company).

The House-to-House Electric Light Supply Company, Limited, in consequence of the approaching completion of its West Brompton Central Station by December 15th, is now prepared to contract with residents in the neighbourhood for a supply of electricity to their houses on the following terms.

Supply of the Light.

The householder can have any number of lamps installed on his premises, but in pursuance of the regulations of the Board of Trade he is obliged, in demanding the light, to state the maximum supply he requires—i.e., he must declare the greatest number of lamps he may want to use at any one time. The householder need only avail himself of the maximum supply (which he can compel the company to have always available for his use) to such extent as he requires. In the event of the householder wishing temporarily to increase the number of lamps available for use beyond that stipulated for in his maximum supply, he can do so by arrangement on giving 48 hours' previous notice in writing to the company.

The maximum supply demanded by the householder will be conveyed to his premises from the central station either by means of underground or overhead mains as the local authority may determine.

After passing the main switch in the house, a simple but *absolutely reliable* meter will register the quantity of electricity actually consumed in the lamps. When any lamps are turned on or off a greater or lesser amount of electricity is being consumed, and a greater or lesser amount is consequently passing through the meter, so that the quantity registered is exactly in proportion to the number of lamps in use from time to time.

Cost of the Light.

The quantity of electricity actually consumed on the premises will be ascertained quarterly, and the following charge made on the basis of a sliding scale, varying with the maximum supply demanded by the householder, as follows:—

1. At the rate of 1s. per Board of Trade unit* for the first 100 hours' consumption of the maximum supply demanded.

2. At the rate of 8d. per Board of Trade unit for the

second 100 hours' consumption of the maximum supply demanded.

3. At the rate of 4d. per Board of Trade unit for any further quantity consumed.

Rent of meter, instruments, &c., 5s. per Board of Trade unit of maximum supply demanded per quarter.

Example.—Suppose that 40 lamps are installed on premises in respect of which a maximum supply of one Board of Trade unit (which will permit of about 20 incandescent lamps of 16 candle-power, or their equivalent, being alight at any one time) has been demanded, and that during the heavy winter quarter 20 lamps have been in use on an average for five hours each evening, the total consumption of electricity registered by the meter would be: 20 lamps $\times$ 5 hours $\times$ 92 days $\times$ 50 watts per hour = 460,000 watt-hours, or 460 Board of Trade units. (50 watts per hour being the quantity consumed by a 16 candle-power incandescent lamp of the best efficiency.)

Then, the maximum supply having been fixed at one Board of Trade unit of 1,000 watt-hours (i.e., the electricity required for 20 16-candle-power lamps for one hour), and the actual consumption having been 460 Board of Trade units, the amount payable would be as follows:—

First 100 units at 1s.	25 0 0
Second 100 units at 8d.	3 6 8
Balance of 260 units at 4d.	4 6 8
Lamp renewals, say 9 at 4s.	1 16 0
Rent of meter, instruments, &c.	0 5 0

£14 14 4

equal to an average charge of 6½d. per Board of Trade unit of electricity, or less than 4s. per thousand cubic feet of gas.

In making comparison with gas, however, it must be remembered that greater economy can be exercised in the consumption of electricity by the facility with which the light can be turned on and off, and the consequent avoidance of the necessity of keeping the lamps alight when not required.

In the event of such an extension of the company's business as would permit of a reduction of charge, all consumers, whether new or old, will enjoy the benefit of the reduced tariff; and it should be further noted that every improvement in the efficiency of incandescent lamps by reducing the quantity of electricity consumed will further diminish the cost of the light to the householder.

Lamps.

The cost of the renewal of lamps is to be borne by the householder who may use those of any maker he may prefer. The company will be prepared to supply lamps of the highest efficiency at the price of about 4s. each.

The best lamps are extremely durable, and ordinarily last for 1,000 hours, so that in the case of an installation of 40 lights, in which each light is on an average in use for 250 hours during the year, there will be an average renewal of about 10 lamps per annum.

Installing.

The cost of installing the electric light on the premises is to be borne by the householder, estimates for which the company will be prepared to furnish free of charge. In the event of the premises being wired by others, the work is to be done to the approval, and subject to the test, of the company's engineer.

As a set-off against this outlay it must be remembered that a large expense, which would be otherwise incurred for painting, decorating, &c., will be avoided.

Fittings.

In cases where the householder may prefer not to do away with his gas-fittings, he can have the electric lamps attached to them. The beauty of the electric light, however, is greatly increased by the use of special electroliers and fittings, which appliances, by the best makers, can be supplied by the company in great variety and on the most advantageous terms.

* A Board of Trade unit (1,000 watt-hours) may be estimated to supply about 20 incandescent lamps of 16 candle-power (or an equivalent number of lamps of smaller candle-power), for one hour.

Summary of Cost of the Light for Various Sized Installations.

(Based upon the probable consumption for the heavy winter quarter.)

20 16-candle-power incandescent lamps, or the equivalent thereof, in a house where the maximum number required to be used at any one time is 10 lamps of 16 candle-power, or the equivalent thereof = a maximum supply demand of 0.50 of a Board of Trade unit. 10 lamps $\times$ 92 days $\times$ 5 hours $\times$ 50 watts = 230,000 watts or 230 units.

First 100 hours of maximum supply demand of 0.50 of 1 unit = 50 units at 1s. ...	£2 10 0
Second 100 hours of maximum supply demand of 0.50 of 1 unit = 50 units at 8d. ...	1 13 4
Balance of 130 units at 4d. ...	2 3 4
Renewal of lamps, 5 at 4s. ...	1 0 0
Rent of meter, instruments, &c. ...	0 5 0
	£7 11 8

Gas at 2s. 9d. per 1,000 cubic feet ... £5 6 3

40 16-candle-power incandescent lamps, or the equivalent thereof, in a house where the maximum number required to be used at any one time is 20 lamps of 16 candle-power, or the equivalent thereof = a maximum supply demand of 1.00 Board of Trade unit. 20 lamps $\times$ 92 days $\times$ 5 hours $\times$ 50 watts = 460,000 watts or 460 units.

First 100 hours of maximum supply demand of 1 unit = 100 units at 1s. ...	£5 0 0
Second 100 hours of maximum supply demand of 1 unit = 100 units at 8d. ...	3 6 8
Balance of 260 units at 4d. ...	4 6 8
Renewal of lamps, 9 at 4s. ...	1 16 0
Rent of meter, instruments, &c. ...	0 5 0
	£14 14 4

Gas at 2s. 9d. per 1,000 cubic feet ... £10 7 5

50 16-candle-power incandescent lamps, or the equivalent thereof, in a house where the maximum number required to be used at any one time is 25 lamps of 16 candle-power, or the equivalent thereof = a maximum supply demand of 1.25 of a Board of Trade unit. 25 lamps $\times$ 92 days $\times$ 5 hours $\times$ 50 watts = 575,000 watts, or 575 units.

First 100 hours of maximum supply demand of 1.25 of 1 unit = 125 units at 1s. ...	£6 5 0
Second 100 hours of maximum supply demand of 1.25 of 1 unit = 125 units at 8d. ...	4 3 4
Balance of 325 units at 4d. ...	5 8 4
Renewal of lamps, 12 at 4s. ...	2 8 0
Rent of meter, instruments, &c. ...	0 10 0
	£18 14 8

Gas at 2s. 9d. per 1,000 cubic feet ... £13 3 0

100 16-candle-power incandescent lamps, or the equivalent thereof, in a house where the maximum number required to be used at any one time is 50 lamps of 16 candle-power, or the equivalent thereof = a maximum supply demand of 2.50 of a Board of Trade unit. 50 lamps $\times$ 92 days $\times$ 5 hours $\times$ 50 watts = 1,150,000 watts, or 1,150 units.

First 100 hours of maximum supply demand of 2.50 of 1 unit = 250 units at 1s. ...	£12 10 0
Second 100 hours of maximum supply demand of 2.50 of 1 unit = 250 units at 8d. ...	8 6 8
Balance of 650 units at 4d. ...	10 16 8
Renewal of lamps, 24 at 4s. ...	4 16 0
Rent of meter, instruments, &c. ...	0 15 0
	£37 4 4

Gas at 2s. 9s. per 1,000 cubic feet ... £26 1 0

S. T. E. & E. Students' Meeting.—A students' meeting was held on Thursday, November 15th, Professor J. A. Fleming, M.A., D.Sc., in the chair. Mr. C. G. Lamb read a paper entitled "A Resumé of the Question of Electrical Oscillations." Professor Fleming made some remarks on the same subject. A short discussion followed, in which Messrs. E. W. Smith, W. H. Shephard and Rance took part.

ON THE INSULATION OF INDUSTRIAL ELECTRICAL INSTALLATIONS.*

By R. V. PICOU.

WHEN an industrial electrical installation is set up, one of the principal points to which the engineer directs his attention is to obtain a good insulation for his system.

The importance of good insulation lies not only in the avoidance of leakages, which are indirectly losses of money, but in the fact that every appreciable escape tends to increase by electro-chemical action, or rather to create a danger of short-circuit through the earth, the result of which is a stoppage in the working of part of the system, or it may even give rise to fire.

Thus the importance attached to the question of insulation is fully justified. But up to the present, at least, it does not seem to have been well defined and discussed, and we will now endeavour to remedy this omission.

Generally, the result obtained by means of very simple methods is observed, and these, while showing a grave defect, do not acquaint us with the exact state of the system. The direct measurement of the insulation resistance is the correct method, but it requires apparatus not generally included among the appurtenances of installations of minor importance. This method, however, is the only one that shows the exact state of affairs, and we must have recourse to it when we wish for exact information.

Again, when data is obtained, we must know how to interpret it, for a good insulation may correspond to a number of ohms infinitely variable, according to the conditions of working adopted for the installation.

Therefore before entering into the experimental arrangements that will enable us to estimate or measure the insulation, it behoves us to try whether it would not be possible to determine by some simple means what is the normal figure to be considered as the admissible minimum.

Whatever kind of installation may be in question, it seems evident that the figure representing the minimum number of ohms of insulation must be higher in proportion as the maximum difference of potential admitted is higher.

I am now considering the matter solely from an electrical point of view, apart from the question of public safety, which is quite distinct, and which will, if we have sufficient space, be introduced under a different heading.

The insulation resistance, X , will therefore be in proportion to E , the maximum electromotive force of the generating machine. But, on the other hand, it seems also logical to admit that the more extensive an installation is, the more numerous and extended its wires will be, and the more reason will there be to decide upon a low normal value for insulation.

If, in fact, we propose to obtain a constant kilometrical insulation, it is clear that the absolute insulation will be weaker in proportion as the number of kilometres is higher. This laying down of a given kilometrical insulation still figures frequently in specifications, but these do not define the conditions of trial. In default of other information, we must conclude that we have to deal with insulations measured by the methods employed in submarine telegraphy, i.e., by immersion. Under these conditions, all wires not covered with caoutchouc or G. P. have no insulation. Now it is a well known fact that excellent installations can be made without employing one metre of such wire.

The laying down of a fixed kilometrical insulation for the wires has not therefore the value of a general indication, which is what we wish to obtain.

We might, no doubt, determine as the minimum a kilometrical insulation by defining the conditions—by saying, for instance, that it must be measured from the wires when put into place, and thus taken in relation

* Communication sent to the Société Internationale des Electriciens, November 7th, 1888.

with perfect earth, which would be better as a definition. But, in order to obtain a figure, two measurements are required, that of the absolute insulation which is easy, and that of the total length of the wires, which is not so easy, or we might even say which is practically impossible in an important installation.

Under these conditions it seems preferable not to seek to solve this problem with a mathematical rigour which is not obtainable; it is better to make an hypothesis which approaches as near as possible to the truth, thus greatly simplifying matters.

The one we propose to adopt is to admit that the development of the wires is in direct proportion to the maximum intensity of the current at the starting of the machines. If we admit this point, the value, X , of the total insulation in ohms must be in inverse proportion to I , the maximum output of the machines.

We should then get

$$X = k \frac{E}{I}$$

k is a coefficient to be determined; but it will be observed that it is quite independent of the mode of installation and of the kind of employment for which the current is used.

As to $\frac{E}{I}$, it is the apparent resistance during action when the installation is in full work. It has the advantage of being obtained immediately without calculation and without any effort of the memory, since the maximum work possible is always known.

To take a numerical example, we will say that a lighting installation employing 400 ampères with an electromotive force of 100 volts will have an apparent resistance of

$$\frac{100}{400} = 0.25 \text{ ohms,}$$

and that its insulation, X , will be equal to k times this fraction.

It remains for us to determine k .

To do this I see no other method than to take the minimum kilometrical insulation of a type of wire of low insulation, then to suppose that this wire will have the greatest possible development compatible with the power of the installation, and from this to deduce the value of insulation we want. If, for example, considering again the case of the installation of 400 ampères and 100 volts, already alluded to, we will suppose:—

- (1) That it only supplies lamps each consuming 5 ampères.
- (2) That each lamp requires a length of 100 metres of wire; we shall evidently be considering the most extended conditions of the system and of the insulation.

There would thus be 80 kilometres of wire, and if we knew the kilometrical resistance the minimum insulation could be at once deduced from it.

The question is thus brought back to that of the measurement of this insulation for industrial wires.

I have already said that wires encased in gutta-percha—that is to say, impermeable—do not enter into the question, the problem in their case being already solved.

But electricians who are desirous of combining economy with security in working very properly only employ these impermeable wires when local conditions render them absolutely necessary. Otherwise they invariably employ wires insulated with cotton, or in any other way, but permeable.

Measurement by immersion is therefore inapplicable.

The subject having been entered upon one day at a private meeting of electricians, several solutions were suggested.

It appeared to me that the one most worthy of attention was that which most nearly approached the actual conditions of the laying down of the wires.

Considering that the wires in a dynamo are generally supported along the whole length of the surfaces which receive them, and that this pressure is also felt upon

the opposite side, I adopted the following arrangement:

Two rectangular plates of polished metal, A and B , are placed horizontally.

Upon one of them, A , which is fixed, a certain length of wire is placed, 1 metre at least, which is arranged zigzag, so that it is all contained between the plates, excepting the ends.

The other plate, B , is laid upon the wire, and connected electrically with plate A .

A variable pressure is then exercised upon plate B , either by weights or other means, and the resistance is measured between the wire and the two plates.

This resistance varies considerably with the pressure, and actually goes on diminishing as the pressure increases.

These are the results of experiments obtained from a type of wire covered with three layers of cotton, wound in reverse layers.

This is about the lowest amount of protection that could be given.

We obtained per metre of the generator, in megohms:

Pressure	0.76	1.23	2.13	4.80	10.8	17.4	23.4
Insulation	48.6	40.5	29.7	23.7	16.2	12.3	11.0

A certain number of other types of wires were also tried: their protection being greater, their insulation was naturally greater also. Let us therefore accept this in seeking the minimum, and suppose that, setting aside practical pressures, the insulation is 10 megohms per metre of the generator.

In the installation already considered, for 80 kilometres of wire there would be an insulation of 125 ohms.

The apparent resistance of the whole being 0.25 ohms, we deduce from it

$$k = \frac{125}{0.25} = 500.$$

This would be the minimum limit, and we are led to formulate the rule that:

"Whatever the electrical installation may be, as regards extent or mode of employment of the current, the insulation resistance between the system and the earth must be equal, at least, to 500 times its apparent resistance, defined by the ratio of the maximum electromotive force to the maximum current."

This does not take into account such items as circuit breakers, interrupters, &c., which may also offer weak points. But it is for this reason that we have supposed an extreme maximum of extent of the wires. On the other hand, these apparatus can be tried before being laid down and only admitted if they are judged to be satisfactory.

It must also be understood that the rule formulated for the *tout ensemble* is also applicable to each part of the system. Lastly, the insulation between the two wires, if it is possible to measure it, will also follow the same rule, but naturally with a value of k equal to 1,000 instead of 500, since the protection is doubled.

It is necessary to observe that the same definition of the minimum insulation may be arrived at in another way.

If we suppose, for instance, that the leakage, that is to say, the current, i , which passes through the insulating materials is a fraction, m , of the total current, I , we arrive at the same result. We get, in fact:

$$e = X i = R I,$$

$$\text{whence } X = \frac{e}{i} R, \text{ and consequently } m = \frac{i}{I} = k.$$

It seems, therefore, that the rule given fulfils as exactly as possible the requirements of the problem.

We have already said that this rule was determined by the purely electrical conditions of the problem, and that it was not applicable to the case in which the electromotive forces employed would be of a dangerous nature.

This case is quite different from the first, and up to

the present it has been much less general; and I think it would be rash to seek to define now the problem of the conditions of establishment of circuits of high tension. The question is quite different, since in this case the insulation is not the only important factor. Two uncovered wires, stretched two millimetres apart, are perfectly insulated; but an electromotive force of some thousands of volts can make the current pass directly through the layer of air. On the other hand, a thick insulation, and the concentric or parallel arrangement of the two cables, have the effect of imparting to the system a capacity not to be neglected.

This is briefly mentioned to show the difficulties of the problem, to which we shall have occasion to refer again.

We will now examine the apparatus used to ascertain the state of insulation of the circuits. The electric bell is frequently employed with a battery of a few elements.

This method is one of the most simple; but it is only efficacious in showing a somewhat grave defect in the insulation.

To give it sensibility, it would be necessary to employ a bell with fine wire, and to multiply the number of elements, even while diminishing their size.

Another apparatus in very general use is Gaiffe's portable galvanometer, which is so well known that we need not describe it. It is much more sensitive than the bell, and is certainly preferable to it.

Experimental apparatus are also to be met with in commerce, consisting of a box containing a little fine wire magneto-electric machine, a polarised bell, and some resistance coils.

This apparatus is introduced between the line and the earth, and it is seen whether the bell works. By introducing into the circuit one of the resistance coils, we can, up to a certain point, ascertain the value of the insulation.

This is a question of appreciation with which a little practice renders us familiar. Unfortunately a capacity of 0.1 microfarad in circuit on the apparatus is sufficient to work the bell, which falsifies the indications when we have to do with lead covered cables.

We must give the preference to instruments capable of giving continuous indications, and known under the designation of earth indicators.

They are formed on the principle of two incandescent lamps connected in series, and a wire one end of which is connected to earth, and the other to the wire connecting the two lamps.

If a contact with earth affects one of the wires, the lamp connected with that wire will be partially shunted. Its brilliancy diminishes while that of the other lamp increases.

At the same time, the earth wire is traversed by a current, and if a bell is introduced, it enters into the working.

This apparatus, which is not expensive, should be in use everywhere. It gives us valuable warnings and permanently controls the condition of the system.

It would be very easy to transform it into a measuring apparatus; all that would be necessary would be to substitute a galvanoscope for the bell and to add a case of resistances.

By connecting this latter by one end to the wire opposite to that in which the defect has shown itself, and by the other to earth, we could bring the galvanometer to zero, by unplugging a suitable resistance. This would be exactly that of the defect.

This method would be particularly applicable to installations in constant action, the working of which could not be stopped during the time necessary to take an ordinary measurement.

By substituting for the two incandescent lamps suitable and equal resistances, we should obtain the desired precision.

I will mention another method, which is very simple, and capable of being applied, without any new instrument, to any installation in existence. This consists in using the voltmeter itself. Almost always, the resistance of this apparatus is inscribed upon its dial; in any case, it is always easy to ascertain it.

Let us take a wire from the voltmeter and connect it to earth. The defect in insulation manifests itself by a deviation in the needle which indicates e volts.

If r is its resistance, $\frac{e}{r} = i$ will be the current passing through it and $\frac{i}{I} = k$ is the actual value of the coefficient of insulation of the system.

The operation must naturally be performed upon both wires.

In conclusion, I will mention a method which enables us to measure the insulation of a system traversed by alternating currents, even of high tension, without interrupting the working of the machines.

There is theoretically no reason why we should not proceed as if the alternating current did not exist, the Thomson galvanometer being in no way influenced by it.

But if the insulation is not really excellent—and this is precisely what we wish to ascertain—the alternating current passing through it will gain such an intensity that it will burn anything.

We must therefore find a method which will allow the continuous current to pass but prevent the alternating current from passing in excess. To do this, we must introduce a bobbin having a very high coefficient of self-induction. Practically we might take two or three transformers, employing only the fine wires, by placing them in series.

The measurement could then be effected without much difficulty.

NEW PATENTS—1888.

16249. "An improved 'bar' or 'bridge' electric light switch." A. P. LUNDBERG. Dated November 9.
16256. "Improvements in electric meters or apparatus for measuring electricity." L. B. MILLER. Dated November 9.
16257. "Improvements in arc lamps." C. E. L. BROWN. Dated November 9.
16264. "Improvements relating to incandescent lamp-holders, applicable also to cut-outs, switches, and the like employed with electric currents." G. BINSWANGER and H. HINER. Dated November 9.
16289. "Improvements in apparatus for gas and electric meters." S. BUNTING. Dated November 10.
16298. "Improved tramcar, omnibus, or other wheeled vehicle, with method of carrying and applying stored electricity for the propulsion of such." T. FRANK. Dated November 10.
16302. "An improved arrangement in construction of primary batteries, by which 'abnormal' voltage per cell is obtained." C. A. JOHANNES, H. SCHROEDER, and H. E. R. SCHROEDER. Dated November 10.
16309. "Electric locking mechanism for safes and for other purposes." L. HUBNER and R. BUSSE. Dated November 10.
16339. "Improvements in the generation of rhythmic electric currents." C. LANGDON-DAVIES. Dated November 10.
16343. "Improvements in incandescent lamps." F. S. WILLOUGHBY and F. C. LYND. Dated November 12.
16438. "Electric register for taking speed of ships." H. WILSON. Dated November 13.
16471. "Improved means or apparatus for reversing and regulating the brushes of dynamo-electric machines partly applicable to electric motors." J. S. RAWORTH. Dated November 13.
16478. "An improved device for use in establishing electrical communication." G. F. REDFERN. (Communicated by D. S. Boivin and E. A. Goumier, France.) Dated November 13.
16479. "Improvements in storage or secondary batteries." H. H. LAKE. (Communicated by H. Walter, United States.) Dated November 13.
16480. "Improvements in and apparatus for the manufacture or treatment of wax, or wax-coated tablets for use in graphophones, or apparatus for recording and reproducing sounds." J. Y. JOHNSON. (Communicated by the Volta Graphophone Company, United States.) Dated November 13. (Complete.)
16481. "Improvements in the mounting of diaphragms of graphophones, telephones, and the like." J. Y. JOHNSON. (Communicated by the Volta Graphophone Company, United States.) Dated November 13. (Complete.)
16484. "Improvements in ungumming and bleaching by electrolysis flax, hemp, cotton, and similar exogenous plants." E. M. H. ANDERSON. Dated November 13. (Complete.)
16570. "Improvements in electric lamps." H. PIERRE. Dated November 14.

16608. "An improved automatic electric signalling apparatus for railways." E. K. INWIN. Dated November 15.

16623. "Improvements in electricity meters." LAURENCE, PARIS and SCOTT, Limited, and W. H. SCOTT. Dated November 15.

16625. "Improvements in electric arc lamps." E. W. ANDERSON. Dated November 15.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1887.

15532. "Improvements in and relating to the use of electricity as a source of explosive power." S. JOYCE, jun. Dated November 14. 8d. The electric explosive consists of a vessel of any suitable material, such as glass or metal, wholly or partially filled with water, which is heated by the passage of an electric current through a coil of wire inserted in it; thus steam is generated and the vessel exploded when sufficient pressure has been attained. Or the before-mentioned vessel may be wholly or partially filled with some decomposable liquid, such as dilute sulphuric acid, which liquid is decomposed by passing through it an electric current by means of two electrodes inserted in it. The mixed gases thus obtained are then caused to reunite by the passage of an electric spark, thus producing an explosion. The claims are 7 in number.

15555. "Improvements in and pertaining to electric motors and their application for charging secondary batteries or accumulators." W. M. MORDEN. Dated November 14. 8d. The main object of this invention is the construction of alternate current motors which shall possess the power of starting from a state of rest, the speed regulating properties attaching to synchronous action and a high efficiency. The nature of this part of the invention will be understood from the following description of one method of carrying it into effect as applied to a motor having a Siemens or a Gramme type of armature, provided with a Gramme collector. On the shaft is placed a simple commutator, for instance, one formed of two parts provided with brushes. The alternate current mains are respectively connected to these brushes, while the commutator plates or segments are joined by means of suitable rubbing contacts to the terminals of the motor; that is, if it be a series motor respectively to one of the collector brushes and to the end of the field circuit. The field magnet is preferably suitably laminated. On switching the whole arrangement into connection with the alternate current supply circuit the motor will start from a state of rest, but as its speed is at first slow, the armature and fields are supplied with an alternating current. As the speed increases the action of the commutator gradually reduces the alternations until the motor is traversed by a current which is continuous in direction. This occurs with a two part commutator, when the alternations of the supply current correspond in rate with the revolutions of the shaft. The tendency of the motor to increase its speed until this synchronism is attained is due to the fact that the more the rate of the alternations of the current traversing it are reduced, the more powerful does the motor action become. When this condition of synchronous action is reached, the motor maintains a constant or nearly constant or synchronous rate of rotation. Any excess of speed beyond this amount is checked by a loss of power due to the alternations setting up inductive reactions, while any diminution of speed is counteracted (within the range of power of the motor) by the inherent tendency of the arrangement to endeavour to attain synchronism. It is, however, preferred to dispense with the collector, and to fit the motor with only a commutator. For this purpose the armature is preferably wound with several open coils, the ends of which are connected to the plates or segments of the said commutator. These plates or segments are preferably made overlapping and with gaps between them, in the manner usual in open coil armatures, for the purpose of preventing short-circuiting of any coil, or open-circuiting of the armature. Similarly, the field circuit is connected to certain plates or segments of the commutator and may be divided into two or more circuits. It will be understood that as the speed of the motor is determined by the number of parts of the commutator, it is necessary to arrange the number of parts, with reference to the rate of alternations of the supply current, to give the required rate of speed. To prevent sparking at the commutator (which, however, except to a small extent, only occurs when synchronism is departed from) the gaps of the commutator may be shunted by a liquid or other resistance. The claims are 7 in number.

15583. "Improvement in electric tramways and railways." B. J. B. MILLS. (A communication from abroad by T. A. Edison, of America.) Dated November 14. 8d. Claim:—An electric tramway or railway, wherein are combined moving cars provided with electric motors proportioned for operation by low tension straight currents, contact conductors with which the cars make a travelling contact, a main supplying circuit extending along the line of the tramway or railway and having a current of high tension, and a number of straight current tension reducers located at intervals along the line of the tramway or railway and near thereto, such tension reducers being connected with the said main supplying circuit and with the said contact conductors and

producing a straight current of lower tension upon the latter, substantially as specified.

15760. "Improvements in the electrolytic treatment of sewage and sea water for the production of certain products therefrom and apparatus therefor." W. WEBSTER, jun. Dated November 17. 8d. The inventor constructs a reservoir, or tank, or a series of the same, in which are contained positive and negative electrodes offering extended surfaces, connected to the poles of a generator of electric currents, which reservoir he divides into compartments of unequal sizes by means of porous tiles, each compartment having an independent outlet through the walls of the reservoir. If it be desired to obtain ammonia from sewage, he places iron negative electrodes in the narrower compartments, and positive carbon electrodes in the wider ones. Both sets of compartments are filled with sewage, and the electrodes are connected with the corresponding poles of a dynamo-electric machine or battery, and the sewage is electrolytically acted upon for a short time. The sewage in the positive compartments is then allowed to run off, and is replaced by fresh sewage, which is then acted upon in the same manner, and so on, until there has accumulated in the charge of the negative compartments sufficient ammonia produced by the electrolytic action. The charges in these compartments are then run off into a separate tank to be subsequently chemically treated, and the compartments are again filled and the process is repeated. The claims are 4 in number.

15801. "Improvements in incandescence electric lamps." W. H. BACK. (Communicated from abroad by A. M. Michel, of Toulouse.) Dated November 17. 11d. The lamp is so constructed and arranged that when the carbon is burnt, for example, the lamp can be taken to pieces, a fresh carbon put in, the lamp put together again, the vacuum made, or gas or vapour introduced to prevent the combustion of the carbon, and the lamp then used again. Similarly, if the glass is broken, it is replaced by another, and after effecting the operations above mentioned, the lamp may be used again without going to the expense of a completely new lamp, whereby considerable economy is secured. The claims are 12 in number.

15877. "Improvements in telegraphic apparatus suitable for indicating the position of a ship's rudder." J. B. WILLIS. Dated November 18. 8d. The apparatus is a step by step telegraphic instrument which dwells on each step and travels rapidly between them. The contacts are made by a spring contact maker fixed to a radial arm, which, as it revolves, carries the contact maker over a ring of alternate conducting and insulating surfaces, and thereby makes or breaks the circuit, by which the signals are repeated on a suitable receiving instrument having a similar step by step movement. The claims are 4 in number.

16185. "Improvements in electric meters." W. J. S. BARBER-STARKY. Dated November 24. 8d. Consists essentially in the winding around a vessel, containing a body of water or other liquid, of a wire or lead of the main circuit to be measured of comparatively small section, a second vessel being provided and filled with an equivalent bulk of liquid. The heat caused in the wire surrounding the first named vessel will cause increased evaporation to take place and a difference of volume thus to ensue between the two vessels. This difference will indicate the amount of units of electricity according to any suitable calibration used within any given time. The claims are 5 in number.

16305. "An improvement in voltaic cells." H. C. DONOVAN and T. WEATHERALL. Dated November 26. 8d. Claim:—A battery trough or tank divided into compartments by plates of carbon forming also the negative electrodes, whose side and bottom edges are sealed into and make a water-tight joint with the insulating and waterproof coating of the tank or trough, in the manner and for the purpose specified.

16458. "Improvements in electric telephones." A. A. CAMPBELL SWINTON. Dated November 30. 8d. According to the invention the inventor dispenses with the separate induction coil or transformer usually employed in connection with microphone transmitters, and he sometimes also dispenses with the permanent magnets generally used in telephone receivers, and he winds the electro-magnets of his telephone receivers each with two wires, one a comparatively short and thick wire of small resistance, which he arranges in circuit with a battery and the microphone transmitter, and the other a long and thin wire of high resistance, which he puts in circuit to line and earth, the arrangement being such that variations in the resistance of the transmitter, consequent on the sonorous vibrations, produce corresponding fluctuations in the strength of the battery current circulating round the thick wire of the receiver electro-magnet, and thus induce other currents of high electromotive force in the fine wire coil which passing to line or earth and thence through the fine wire coil of a similarly wound and arranged receiver at a distant station actuate the said distant receivers in the ordinary manner. The claims are 3 in number.

16772. "Improvement in electric bells." J. A. MACDONALD. Dated December 6. 6d. Claims:—1. The use and application of glass, or porcelain, or earthenware, or artificial stone, in the construction of the gong, covers and bases, to be combined with the electro-magnetic movements and terminals in the manufacture of electric bells. 2. The production of the gong together with its supporting stem in a single piece of casting or moulding in the manufacture of electric bells.

1888.

3516. "A new or improved apparatus or 'inductometer' for measuring the intensity of a magnetic field." G. MIOR. Dated February 20. 8d. Is based upon the principle that if a capillary tube be connected to the horizontal or connecting branch of a U-shaped tube, and arranged parallel to the other branches of such tube, the said branches being filled with mercury, and an exciting current passed therethrough, and the horizontal portion of the tube be placed in a magnetic field of any kind, at right angles to the plane of force, then the mercury will rise up into the capillary tube to a height proportional to the intensity of the magnetic field and to that of the exciting current. The claims are 3 in number.

3906. "An improvement in plates for secondary voltaic batteries." B. M. DRAKE and J. M. GORHAM. Dated March 14. 8d. Claim.—The manufacture of grid plates for secondary voltaic batteries by casting them with ribs of depth greater than the thickness of the finished plate, and burnishing down the edges of the ribs so as to produce burrs or lips projecting inwardly towards the cells into which the plate is divided, substantially as and for the purpose set forth.

5586. "Improvements relating to holders or supports for electric incandescent lamps and to contact-devices for use therein." H. E. LAKE. (Communicated from abroad by C. Grivolas, Fils, of Paris.) Dated April 14. 8d. Claims:—1. The employment of contact pistons formed by the combination of a nut, pin, and helical spring, for lamp holders or supports. 2. The various arrangements of interruptors for lamp holders or supports, substantially as described and represented in the drawings, and in general the arrangement in lamp holders or supports of an interrupter made of insulating material and of any suitable shape, and traversed by two metal pieces whose extremities can be set in communication on the one hand with conducting pieces connected to the filaments of the lamp, and on the other hand with metal pieces communicating with the conducting wires, the said interrupter being adapted to receive either a motion of translation, or rotary motion, or oscillating motion upon any axis, which motions are designed to make or break the above-mentioned contacts, that is to say, to allow or interrupt the passage of the current through the lamp. 3. The employment in a lamp holder or support having interruptors, of a part having the shape of an ordinary gas or water cock in which the metal is replaced by insulating material and the hole or holes are occupied by conducting pieces. 4. The combinations of a snug with notches, and of projecting parts with a screw threaded ring or collar, for the purpose of connecting the several parts of the lamp holder or support. 5. The arrangement of a rod adapted to shift to the interior of the lamp holder or support a movable part the displacement of which causes the interruptions of the circuit. 6. The arrangement of a lever and of a double lever which enable the lamp to be lighted and extinguished by a downward movement, and their application to any kind of lamp holders or supports, the said levers being made of the described or other suitable shape. 7. The improved lamp holder or support consisting of the parts constructed and combined, substantially as described with reference to either of the modifications shown in the drawing.

6075. "A new and improved method of utilising electricity for heating and lighting buildings, railway vehicles, and other places, and for operating brakes and signals on railway trains." E. E. RICE. Dated April 24. 1s. 1d. Consists in the use of inductive transformers. The low tension heating currents are produced by an inductive transformer, the primary circuit of which is usually of comparatively fine wire, and receives alternating or intermittent high tension currents from any suitable source. The secondary coils are of very large wire having few convolutions and extremely low resistance. The electric heaters are connected in parallel order between the large secondary conductors, and the transformers should be placed as near to the point from which the heat is distributed in order to save cost of conductors and absorption of current thereby. The claims are 14 in number.

6614. "Improvements in electrical illumination of clock dials and apparatus in connection therewith." E. G. CRAVEN. 8d. Dated May 3. Has for its object the momentary illumination of the dial of a clock at stated intervals of time, said illumination being effected automatically by the mechanism of the clock. The claims are 4 in number.

8611. "An improved form of galvanic belt for medical purposes." W. LAUGHTON. Dated June 12. 8d. Claims:—1. The construction of an electric belt in which the battery, attached to the inner surface of the band, is prevented from coming in contact with the body when the belt is worn, by cushions or raised surfaces placed along and over the ends of the copper plates, substantially as described. 2. The construction for use in making belts for medical purposes of a battery consisting of plates of copper and zinc, in which each pair of elements is electrically connected with the next pair by thread interwoven or interlaced in the copper plate, substantially as described.

8637. "Improvements in electric clocks." A. L. PARCELLE. Dated June 12. 8d. Has special reference to electric clocks of the character shown in Letters Patent No. 5,328, 12th of April, 1887, though not necessarily confined to clocks of that particular type. The claims are 18 in number.

9661. "Improvements in telephone transmitters." A. J. BOULT. (Communicated from J. Emner, junior, of America.) Dated July 3. 8d. Consists in the combination with a diaphragm electrode of carbon, iron, platinum, or aluminium, of movable or

balanced electrodes hung upon a rod or bar of metal mounted upon the diaphragm and insulated therefrom; furthermore, the invention consists in the combination with a diaphragm electrode of balanced electrodes hung upon a rod or bar of soft metal, and a piece of soft rubber, serving at once as an insulator, and, being adjustable, as means for regulating the distance of the lower ends of the balanced electrodes from the diaphragm electrode, while presenting a cushion to lessen the danger of breakage of the balanced electrodes in their adjustment and in their action; furthermore, the invention consists in a telephone transmitter, in which aluminium is employed as an electrode; and, finally, the invention consists in various novel details of construction, all as hereinafter more fully set forth and shown in the drawings. The claims are 8 in number.

9663. "Improvements in or relating to electrical typewriters." A. J. BOULT. (A communication from J. F. McLaughlin, of America.) Dated July 3. 8d. This invention relates to a combined mechanical and electro-mechanical movement for the type levers of electrical type-writers that is to say: has for its object to adapt the aforesaid instruments when placed respectively at two extremities of a line wire to record or imprint a letter or character locally at one extremity of said line by a single mechanical action of the key board and corresponding type-lever to utilise such mechanical action to simultaneously impart and transmit an electrical impulse to the distant extremity of the line and to effect the registration of a corresponding letter or character at such distant extremity by the electro-mechanical movement of a similar type-lever. The claims are 16 in number.

9901. "Improvements in magneto-electric apparatus." W. R. LAKE. (Communicated from abroad by W. Humans, of America.) Dated July 10. 8d. The main feature of the invention is a double armature composed of two cores each with its coil, both cores and both coils being arranged on a single axis in order to form an armature adapted for use as a double revolving armature. The claims are 3 in number.

10631. "Improvements in electrical night signalling apparatus." E. KASHELOWSKY. Dated July 23. 8d. Relates to a system of signalling at sea, wherein differently coloured electric lamps are brought to view singly or in groups, which lamps, in order to maintain a constant resistance in the machine, are exchanged for, or replaced by, compensation lamps of equal power. In carrying out the invention the inventor employs in connection with differently coloured lamps for producing the signals which are usually required at sea, a supplementary resistance (preferably in the form of lamps which can be used for ordinary lighting), and apparatus by means of which the electric current is automatically switched on to the supplementary resistance when the signal lamps are being changed or extinguished. The claims are 3 in number.

10691. "Improvements in or relating to electrical transmitting instruments." A. J. BOULT. (A communication from J. F. McLaughlin, of Philadelphia.) Dated July 24. 8d. Relates to transmitting instruments for transmitting electrical impulses over a line circuit, and is designed for use in conjunction with the improved electrical type writer which operates as a receiver and forms the subject matter described in specifications Nos. 7,303 and 10,683 of 1887. The improved transmitter is utilised to convey or transmit electrical impulses by the manipulation of the keys of the instrument at one extremity of a main line circuit, to a similar instrument located at the other extremity of said line, and this organisation of apparatus is used in connection with a printing telegraph, or with any suitable receiver which records the message in legible form, each transmitter at the respective stations in the line circuit being suitably electrically connected with such local receiver, so that by the manipulation of the keys of the transmitter at one end of a line, the electrical impulses are sent from a suitable source of electricity, and do synchronously and simultaneously actuate the registering mechanisms of such local receivers. The claims are 7 in number.

10954. "Improvements in or connected with dynamo-electric machines." E. H. GIST. Dated July 28. 6d. Claims:—1. A dynamo-electric machine in which the iron parts of the field magnets are composed of insulated wire or tape (or of wires, tapes or sections insulated or separated from each other) the longitudinal axes of the said wires or tapes being parallel or nearly parallel to the axes of the magnets, similar to the iron cores of armatures or transformers; also the exciting of field magnets constructed as described with alternating currents, and the combination of several machines excited as described and joined in parallel. 2. A dynamo-electric machine without pole piece, substantially as described. 3. A dynamo-electric machine without pole, substantially as described.

11108. "Improvements in electric conductors or cables, and in means for preventing disruptive discharges therefrom." P. M. JUSTICE. (A communication from abroad by E. G. Acheson, of America.) Dated July 31. 8d. Consists in providing means whereby this discharge may be caused to take place at such a point as to prevent the destruction of the insulation, and before its potential is sufficiently great to pass through the dielectric surrounding the conductor, or to cause a dangerous strain upon it. The claims are 7 in number.

11338. "Improvements in telephone line circuits." L. KILMER. Dated August 4. 8d. The object of the invention is to destroy upon telephone wires of all lengths:—1. The noise produced in telephones by telluric or earth currents, commonly called "buzzing." 2. The telegraphic induction of adjacent parallel

or other telegraph wires. 3. The telephonic or speech induction of adjacent parallel or other wires. The invention consists in cutting the metallic circuit at each station and reuniting the two ends thus cut by a column of alcohol, reduced, in preference, to 32° centigrade.

11705. "Improvements in apparatus for measuring electric currents and recording the amount of electric energy consumed in a given circuit." W. P. THOMPSON. (A communication from abroad by the Westinghouse Electric Company, of Pittsburgh.) Dated August 14. 8d. The principal elements employed in the construction of the meter are, first, an armature of metal capable of rotation; second, an electric circuit which is so arranged that when it is traversed by alternating electric currents, a field of force is induced having a given polar line or axis with reference to the armature; and, third, a circuit so related to the first circuit that currents are produced in such second circuit by the action of those in the first, the phases of which succeed those of the currents in the first circuit, and set up for the armature a second field of force, the axis of which intersects that of the first. The claims are six in number.

11779. "Improvements in galvanometers." E. E. DE FACIEU. Dated August 15. 8d. Relates to certain improvements in the arrangement, combination, and construction of parts of galvanometers, and refers more particularly to the type of instruments known as "mirror" galvanometers, and consists chiefly in an arrangement by which the sensitiveness of the instrument can be altered by changing the plane of the coils. The claims are 3 in number.

CORRESPONDENCE.

The Ries Electric Railway.

In your article of last week headed as above you mention that the "Return of power of descending grades" is an old idea rejuvenated, and that very little credit accrues to anyone in the year of Grace 1888 for putting forth such a device as an "invention." It is astonishing, and has often been noticed with amazement, how simple ideas made public and perhaps patented years ago are resurrected and brought forth as new and noteworthy improvements. Perhaps Mr. Ries has not made himself familiar with the patents taken out in this country for points similar to his improvements or he would have noticed a patent of Mr. Radcliffe Ward, 2,538 of 1881, I think it is, from memory, wherein his invention (?) is pretty plainly described.

Seven years ago a great deal of merit was due to ideas which now every student of electro-technology is or ought to be acquainted with. So far as I am aware, the above patent is the first accurate description of the means of electro-breaking or storing the kinetic energy of a car requiring to be stopped to help it again on starting. Perhaps "the Ries Electric Railway" is another instance of the Yankee smartness alluded to in your issue of the 9th inst. The *Western Electrician* might be able to say?

November 19th, 1888.

C. H. Yeaman.

Curious Light Effect in Incandescent Lamps.

In reply to Mr. Crouch's query, I am of the opinion that the phenomenon observed by him is due partly to static induction, and partly to the vibrations of separate air molecules.

In the first place, the brine surrounding the lamp becomes charged statically; and immediately the filament of the lamp becomes of the opposite polarity by induction. As soon as this condition is set up the few remaining molecules of air left in the lamp vacuum become electrified. Those nearest the inside surface of the lamp globe receive a static charge and then immediately fly to the filament and then back again to the glass to receive another charge and so on with enormous rapidity, and at the same time form vehicles for the conveyance of static charges of current, between the two poles of the charged circuit they are between, viz., the filament and the inside surface of the lamp globe.

The inside of the lamp glass undergoes a kind of molecular bombardment from the molecules of air constantly impinging on its surface, and this may make it luminous, and the passage of statically charged molecules of air through the vacuum of the lamp, which under these circumstances would take place with enormous rapidity, would probably produce a luminous effect.

Jno. Palmer.

[We beg to refer our correspondent to Mr. Vander Weyde's explanation of the phenomenon on another page.—EDS. ELEC. REV.]

Sparking coils.

We have examined the description of coil alluded to by your correspondent, Mr. Coote, and find that it is merely a re-invention of the Apps core by C. F. Brush, and has absolutely nothing in common with ours, except that it is mounted vertically on its base which certainly is the least convenient form for so long a model.

Fyke & Barrett.

November 20th, 1888.

Re Underground Cables.

In your last issue there is a note concerning underground cables, in which you quote the opinion of Mr. A. M. Renshaw as an example of the result of American experience.

With regard to this, I would wish to point out that before the full value of such experience can be appreciated, it is necessary to have some description of the cables themselves, and of the methods of laying them.

I am not prepared to dispute the statement that "no underground cable has stood the strain of a 2,000-volt arc light current for two years," as but comparatively few installations of this kind have been tried; but before agreeing with the more general statement that "there is no cable in existence that will not give out when steadily subjected to such a strain," I should like to have a little more information as to the range of Mr. Renshaw's experience, more especially as it is only fair to assume that he, as manager of a company owning a considerable mileage of overhead wires, is as much interested in overhead work as the parties to whom he refers in the passage quoted by you are interested in underground cables.

Turning, now, to cables for the alternating current transformers system, to which, as I understand, your article refers, the experience is more favourable, as there are in Europe underground cables which have stood the test of two years' working with currents of 2,000 volts, and have stood that test very well.

As what has been done once can generally be done again, I think that even one success should more than counterbalance any number of failures, where perhaps neither the best cables, nor the best method of laying them, have been employed.

Many general statements have been made about the impracticability of using high voltages on underground cables, but there is a decided want of definite information on this subject, and I feel sure you would confer a great benefit on all those interested if you, or any of the readers of your Journal, could furnish a list of places where such a system has been tried, with a description of the cable and method of laying, and could say whether they have been successful or not.

Stuart A. Russell.

November 20th, 1888.

[We should be very glad if our readers will carry out the suggestion contained in the last paragraph of Mr. Russell's letter. Much valuable information might be obtained thereby, and the chances of failure of underground cables would probably be much reduced.—EDS. ELEC. REV.]